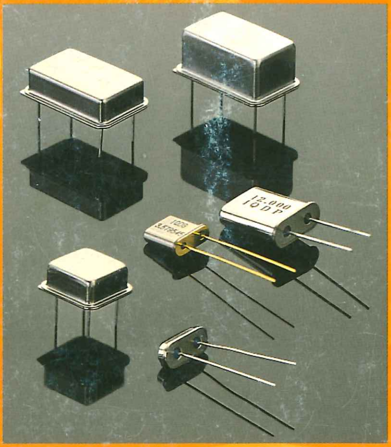
IQD Limited



Crystal Product Data Book 1994

Approvals

BS5750 Part 2

BS9000 Part 4

CECC RP14 Part 1

ISO9002 Part 2

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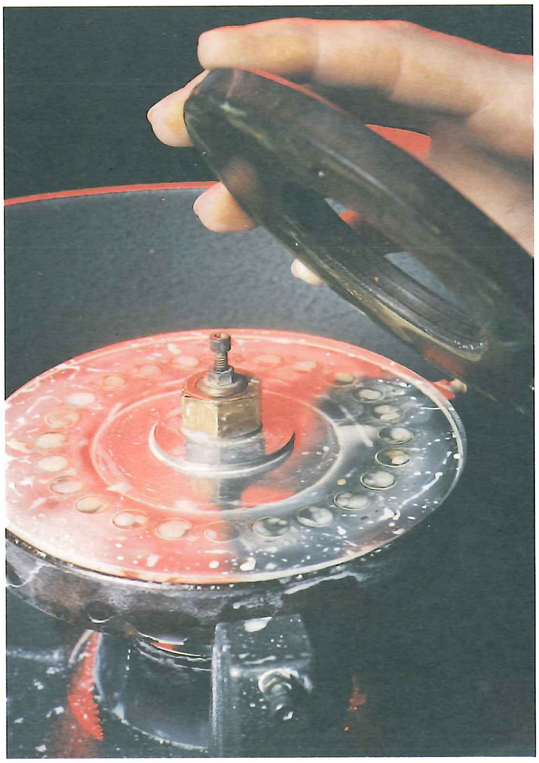
INTRODUCTION & ORDERING INFORMATION

COMPANY PROFILE

IQD Limited is a specialist manufacturer of quartz crystals and related products. Since its formation in 1974, its name has become synonymous with the very best in quality and service in the crystal industry.

Operating from its head office in Southwest England, IQD manufactures crystal components for major Original Equipment Manufacturers (OEM's) throughout the world. Its components are used in all areas of high technology including aerospace, automotive, computers, communications, satellites and space; in products as diverse as nuclear submarines and television.

Machine Lapping Quartz Crystals at our Crewkerne factory



From low cost commercial grade product to the most stringent requirements of military and professional grade applications, IQD maintains its quality excellence. This commitment to quality is reinforced by IQD's approval to quality standards BS5750, BS9000, EN29002, ISO9002 and CECC68000.

The range of products covers all aspects of quartz crystals, crystal oscillators and crystal filters. In addition ceramic resonators & filters and crystal holders & clips are available.

Through close consultation with its customers, IQD offers full application support, from initial design stage through to full production.

Our experienced sales engineers are supported by a sophisticated computer system with multiple terminals for handling all aspects of the business including forward scheduling of sales, purchases and stock, as well as computer aided design.

IQD's ability to service customers requiring urgent delivery is unsurpassed. With one of the largest stocks of crystal products in Europe and an express made-to-order (MTO) service that can manufacture non-stock frequencies as quickly as 3 days, most urgent requirements can be met.

Special test facilities are available including full burn-in programmes for crystals and oscillators and military oscillator testing to MIL standard 55310.

ORDERING INFORMATION

Office Hours

9am to 5pm, Monday to Friday except UK bank holidays

Minimum Order Charge

Account orders £25.00; Prepaid £25.00;
or foreign currency equivalent

Quotations

Quotations made by IQD are valid for 4 weeks unless otherwise stated.

Certificate of Conformance (C of C)

C of C's are available upon request if the order is confirmed in writing by fax, telex or letter.

Order Acknowledgment

Order acknowledgments are sent out for all orders except for ex-stock items being shipped within 3 days of order.

Order Cancellation

Purchase orders for made-to-order products are non-cancellable

Despatch

Orders received by 4pm for ex-stock items can normally be despatched the same day if specifically requested at time of order.

Terms

30 days from end of month of invoice for approved credit accounts.

Payment from Overseas

We can operate an account for you in any one of a number of different currencies; please agree this with your sales contact when placing your first order. Please ensure that remittance in the agreed currency reaches us in full without deductions of charges.

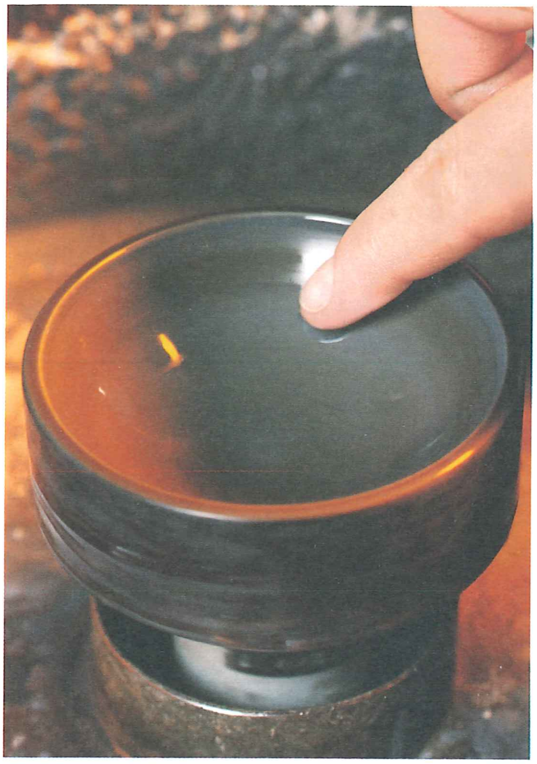
Returns

Customers wishing to return goods for whatever reason should contact our sales administration first, otherwise considerable delays can result in processing the return.

Specifications

As part of its continuing efforts to provide customers with the very latest technology in crystal components, IQD reserves the right to change specifications, designs and models without notice.

Contouring Quartz Crystals by hand to individual customer specifications



Standard Terms & Conditions

Acceptance of an order is subject to availability of manufacturing materials; we reserve the right to revise prices due to fluctuations in international exchange rates. Ownership of the goods the subject of an order shall not pass to the purchaser until actual payment is received. No contract for supply of made-to-order items can be cancelled once manufacture has started. Payment terms are strictly 30 days from end of month of invoice for approved credit accounts. If any invoice remains unpaid beyond the agreed terms all other unpaid invoices will immediately become due and full payment will become due for any oustanding orders for made-to-order items. Interest will be charged at 2% per month compound on overdue invoices. Only English law will apply.

BESTELLINFORMATIONEN

UNTERNEHMENSÜBERSICHT

IQD Limited ist ein Spezialhersteller von Quartzkristallen und verwandten Produkten. Seit seiner Gründung im Jahre 1974 ist sein Name zu einem Synonym für erstklassige Qualität und unübertroffenen Service in der Kristallindustrie geworden.

Von seiner Hauptgeschäftsstelle im Südwesten Englands aus stellt IQD Kristallkomponenten für führende Hersteller von Primärgeräten in allen Teilen der Welt her. Seine Komponenten werden in allen Bereichen hochentwickelter Technologie verwendet, einschließlich Aerospace, Automobil, Computer, Kommunikation, Satelliten und Raumfahrt - in so vielseitigen Produkten wie nukleare U-Boote und Fernseher.

Von preisgünstigen Produkten der Handelsgüte bis hin zu den strengsten Anforderungen für militärische und fachspezifische Anwendungen: IQD wahrt seine Exzellenz für Qualität. Diese Verpflichtung zur Qualität wird verdeutlicht durch die Zulassung des IQD zu den Qualitätsnormen BS5750, BS9000, EN29002, ISO9002 und CECC68000.

Die Produktreihe umfaßt alle Aspekte der Quartzkristalle, Kristalloszillatoren und Kristallfilter. Darüberhinaus sind Keramikresonatoren und -filter und Kristallbehälter und -klammern erhältlich.

Durch seine enge Beratung mit seinen Kunden bietet IQD eine komplette Anwendungs-unterstützung, vom anfänglichen Designstadium bis zur vollen Produktion.

Unsere erfahrenen Vertriebsingenieure werden durch ein spezialisiertes Computersystem mit einem Multiterminal zur Handhabung aller Geschäftsaspekte unterstützt, einschließlich Vorausplanung der Verkäufe, Einkauf und Warenbestand sowie rechnergestütztes Design.

Die Fähigkeit des IQD, Kunden mit dringenden Lieferungsanforderungen gerecht zu werden, ist ohnegleichen. Dank einer der größten Warenbestände von Kristallprodukten in Europa und einem Express- Service für Spezialanfertigungen, wo nicht vorrätige Frequenzen in nur 3 Tagen angefertigt werden können, wird selbst den dringendsten Anforderungen entsprochen.

Spezielle Testeinrichtungen sind erhältlich, einschließlich vollständige Einbrennprogramme für Kristalle und Oszillatoren sowie militärische Oszillatortests gemäß der MIL Norm 55310.

BESTELLINFORMATIONEN

Geschäftszeiten

9 bis 17 Uhr, montags bis freitags, mit Ausnahme britischer Feiertage.

Gebühr für Mindestbestellung

Kontobestellungen £25,00; Vorausbezahlung £25,00.

Preisangaben

Von IQD vorgenommene Preisangaben sind, wenn nicht anders angegeben, 4 Wochen lang gültig.

Übereinstimmungszertifikate

Übereinstimmungszertifikate sind auf Wunsch erhältlich, wenn die Bestellung schriftlich per Telefax, Telex oder Brief bestätigt wurde.

The use of gold evaporation which improves long customer specifications

Auftragsbestätigung

Auftragsbestätigungen werden für alle Bestel-lungen versandt, mit Ausnahme von vorrätigen Produkten, die innerhalb von 3 Tagen nach Eingang der Bestellung verschifft werden.

Annullierung eines Auftrages

Bestellungen für Spezialanfertigungen können nicht annulliert werden.

Auslieferung

Bestellungen für vorrätige Produkte, die vor 16 Uhr eingehen, können im Normalfall am gleichen Tag ausgeliefert werden, wenn dieses zum Zeitpunkt der Bestellung angegeben wird.

Zahlungsbedingungen

Für genehmigte Kreditkonten - 30 Tage ab Monatsende des Rechnungsdatums

Auslandszahlungen

Wir richten Ihnen gern ein Wührungskonto in anderen Wührungen nach Wunsch ein. Bitte vereinbaren Sie dies bei Ihrem ersten Auftrag direkt mit dem Verkaufspersonal. Stellen Sie bitte sicher, daß Ihre Überweisungen in der vereinbarten Wührung die Gesamtsumme (ohne Gebührenabzug) abdecken.

Rücksendung

Kunden, die aus welchen Gründen auch immer Waren zurückzusenden wünschen, möchten sich vorab bitte an unsere Vertriebsverwaltung wenden, da sonst beträchtliche Verzögerungen bei der Bearbeitung der Rücksendung eintreten können.

Spezifikationen

Als Teil seiner anhaltenden Bemühungen, Kunden mit der allerneusten Technologie für Kristallkomponenten zu versehen, behält sich IQD das Recht vor, Spezifikationen, Designs und Modelle ohne vorherige Mitteilungen zu ändern.

The latest precision evaporation plant, newly installed at our Crewkerne factory as part of our expansion programme

Allgemeine Geschäftsbedingungen

Die Annahme eines Auftrags erfolgt, solange der Vorrat an Herstellungsmaterialien reicht. Wir behalten uns das Recht einer Preisanpassung gemäß Anderungen in den internationalen Wechselkursen vor. Die Auftragsware bleibt solange im Eigentum des Herstellers, bis die tatsächliche Rechnungszahlung eingegangen ist. Nach Beginn der Herstellung kann ein Liefervertrag für nach Maß angefertigte Auftragsware nicht mehr gekündigt werden. Der Zahlungstermin für genehmigte Kreditkonten ist strikt 30 Tage ab Monatsende des Rechnungsdatum. Sobald der Zahlungstermin einer Rechnung überschritten ist, werden alle weiteren, noch ausstehenden Rechnungen umgehend fällig, und die vollständige Zahlung für jegliche noch ausstehenden, nach Maß angefertigten Auftragswaren wird ebenfalls umgehend fällig. Auf überfällige Rechnungen wird ein Zins und Zinseszins in Höhe von 2% pro Monat zugerechnet. Es gilt ausschließlich englisches Recht.

INFORMACION RELATIVA A PEDIDOS

PERFIL DE LA COMPAÑIA

IQD Limited es un fabricante especializado de cristales de cuarzo y productos relacionados. Desde su creación en 1974, su nombre se ha convertido en sinónimo de la mejor calidad y servicio en la industria del cristal.

IQD, que opera desde su oficina central situada en el sudoeste de Inglaterra, manufactura componentes de cristal para los principales Fabricantes de Equipos Originales (Original Equipment Manufacturers (OEM)) de todo el mundo. Sus componentes se utilizan en todas las áreas de alta tecnología, incluyendo la aeroespacial, automotriz, computación, comunicaciones, satélite, espacial; en productos tan diversos como submarinos nucleares y televisión.

IQD mantiene su excelencia en calidad desde los productos de grado comercial de bajo costo hasta las aplicaciones de grado militar y profesional de requisitos rigurosos. Este compromiso de calidad se ve reforzado por la aprobación por parte de IQD de los estándares de calidad BS5750, BS9000, EN29002, ISO9002 y CECC68000.

La gama de productos cubre todos los aspectos de los cristales de cuarzo, osciladores de cristal y filtros de cristal. Además hay disponibles filtros y resonadores de cerámica, y sujetadores y soportes de cristal.

A través de una estrecha consulta con sus clientes, IQD ofrece un soporte completo de aplicaciones, desde la etapa del diseño inicial hasta la producción final.

Nuestros experimentados ingenieros de ventas están respaldados por un sofisticado sistema de computación con múltiples terminales, para el manejo de todos los aspectos del negocio incluyendo la planificación adelantada de las ventas, compras y existencias, así como el diseño asistido por ordenador.

La capacidad de IQD para dar servicio a los clientes que necesitan una entrega urgente es inmejorable. La mayoría de las necesidades urgentes pueden satisfacerse gracias a que cuenta con una de las existencias más grandes en Europa de productos de cristal y con un servicio rápido de fabricación por encargo (made-to-order (MTO)) que puede fabricar en tan sólo 3 días frecuencias de las cuales no haya existencias.

Hay disponibles recursos para pruebas especiales, incluyendo programas completos de grabado a fuego para cristales y osciladores y para la prueba de oscilador militar según la norma MIL 55310.

INFORMACION RELATIVA A PEDIDOS

Horas de Oficina

9 hs. a 17 hs. de lunes a viernes, excepto los festivos bancarios del Reino Unido

Cargo Mínimo por Pedido

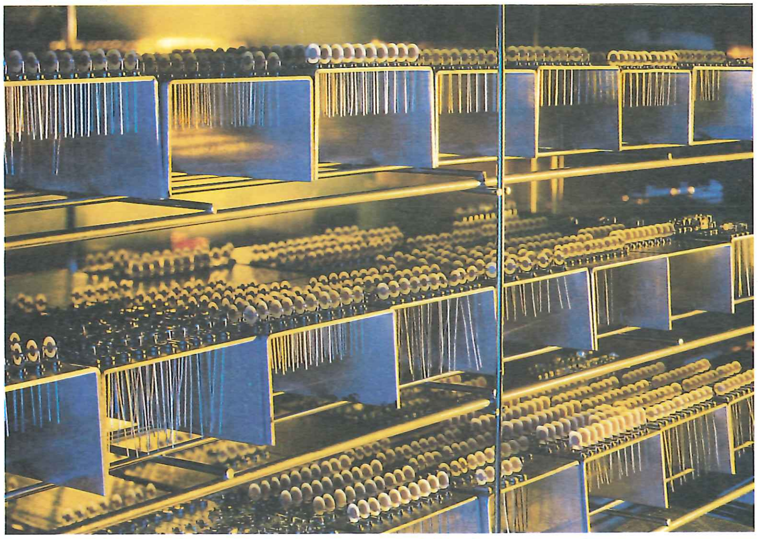
Pedidos sobre cuenta £25,00; Pagado con antelación £25,00

Presupuestos

Los presupuestos hechos por IQD son válidos durante 4 semanas, salvo que se indique lo contrario.

Certificado de Conformidad (C de C)

Los C de C están disponibles a solicitud si el pedido se confirma por escrito en telefacsímil, télex o carta.



High temperature storage to reduce aging

Acuse de Recibo del Pedido

Se envían acuses de recibo para todos los pedidos, excepto para los pedidos de artículos en existencias que se envían dentro de los 3 días del pedido.

Cancelación de Pedidos

Los pedidos de compra para los productos hechos a pedido no son cancelables.

Despacho

Los pedidos recibidos hasta las 16 hs. para los artículos en existencias, normalmente pueden despacharse el mismo día si se lo solicita específicamente en el momento del pedido.

Condiciones de pago

30 días desde el fin del mes en que se emitió la factura para las

cuentas de crédito aprobadas.

Pago Desde El Extranjero

Podemos operar una cuenta para su uso personal en varias monedas diferentes; por favor convéngalo con su vendedor cuando haga su primer pedido. Por favor, tome las medidas necesarias para que la remesa en la moneda especificada nos llegue completa y sin que se hayan descontado cargos.

Devoluciones

Los clientes que deseen devolver mercancías por cualquier motivo, primero deberán ponerse en contacto con nuestra administración de ventas; en caso contrario pueden producirse considerables demoras en el proceso de la devolución.

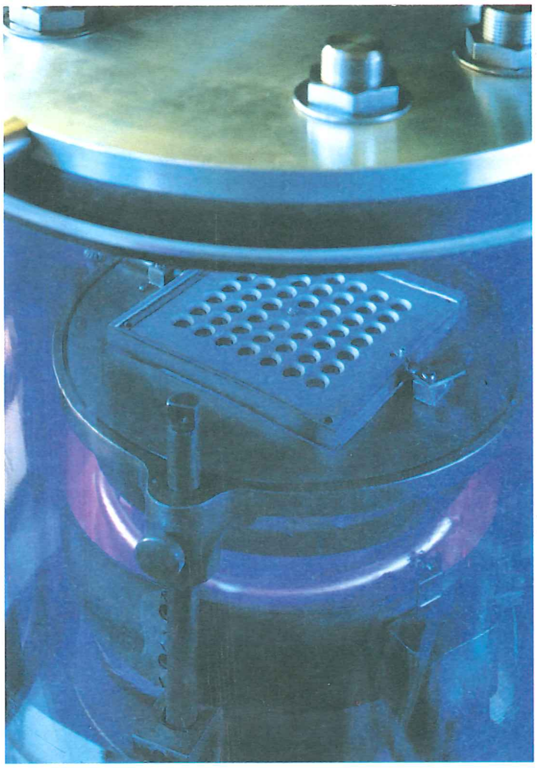
Especificaciones

Debido a sus continuos esfuerzos para proporcionar a sus clientes la última tecnología en componentes de cristal, IQD se reserva el derecho de cambiar especificaciones, diseños y modelos sin ningún aviso.

Terminos Y Condiciones De Norma

La aceptación de un pedido estáásujeta a la disponibilidad de los materiales con que se manufacturarááel producto; nos reservamos el derecho de modificar los precios que se ven afectados por fluctuaciones de las tasas de cambio internacionales. El comprador no obtendrááIa propiedad de las mercaderias especificadas en los pedidos hasta que no se reciba el pago correspondiente. No se cancelarááun contrato para el suministro de artículos hechos a pedido una vez que haya comenzado la manufactura de éstos. Los términos de pago especifican un plazo máximo de 30 días desde el fin del mes en que se emitió la factura para las cuentas de crédito aprobadas. Si una factura no se ha pagado en dicho plazo todas las restantes serán pagaderas inmediatamente conjuntamente con el pago completo do los contratos devengados para artículos hechos a pedido. Se agregarááun interés compuesto del 2% mensual para todas las facturas devengadas. Sólo se aplicarááIa ley inglesa.

Aluminium Evaporation



RENSEIGNEMENTS POUR COMMANDER

LE PROFIL DE L'ENTREPRISE

IQD Limited est un fabriquant spécialisé de cristaux de quartz et de leurs produits associés. Depuis sa fondation en 1974, son nom est devenu synonyme de ce qui se fait de mieux dans le domaine de la qualité et du service dans l'industrie du quartz.

Depuis son siège social situé dans le sud-ouest de l'Angleterre, IQD fabrique des composants en quartz pour les principaux constructeurs de matériel dans le monde entier. Ses composants sont utilisés dans tous les secteurs de la technologie de pointe, y compris l'aerospatiale, l'automobile, l'informatique, les systèmes de communication, les satellites et l'espace : pour des produits aussi divers que des sous-marins nucléaires et des télévisions.

Allant du produit de qualité commerciale bon marché aux exigences rigoureuses des utilisations de qualités professionnelle et militaire, IQD maintient son excellente qualité. Cet engagement à la qualité est renforcé par son homologation pour les normes de qualité BS5750, BS9000, EN29002, ISO9002 et CECC68000.

Sealing by resistance welding

La gamme des produits recouvre tous les aspects des cristaux de quartz, des oscillateurs à quartz et des filtres à quartz. De plus, nous offrons des résonateurs et des filtres en céramique ainsi que des supports et des colliers en quartz.

Grâce à des consultations rapprochées avec ses clients, IQD offre un soutien complet d'utilisation, allant de la conception initiale jusqu'à la production finale.

Nos ingénieurs de vente expérimentés s'appuient sur un système informatique sophistiqué aux terminaux multiples pour gérer tous les aspects des activités, y compris le planning des ventes à long terme, les achats et les stocks, ainsi que la conception assistée par ordinateur.

La capacité de IQD à assister les clients qui nécessitent une livraison urgente est sans rival. Avec l'un des plus grands stocks de produits à quartz en Europe et un service express de fabrication sur commande qui peut fabriquer des fréquences qui ne sont pas en stock dans un délai aussi court que 3 jours, il est possible de satisfaire la plupart des demandes.

Des installations spéciales d'essai sont disponibles, comprenant des programmes complets de cuisson pour les cristaux, les oscillateurs et les essais d'oscillateurs militaires en conformité à la norme MIL 55310.

RENSEIGNEMENTS POUR COMMANDER

Heures de bureau

De 9h00 à 17h00, du lundi au vendredi, sauf les jours fériés britanniques.

Coût minimal d'une commande

Commande sur compte 25,00 £. Payé d'avance 25,00 £.

Offre de prix

Les offres de prix faites par IQD sont valables pendant 4 semaines sauf indication contraire.

Certificat de conformité (C de C)

Les C de C sont disponibles sur demande si la commande est confirmée par écrit par fax, télex ou lettre.

Accusé de réception d'une commande

On envoie un accusé de réception d'une commande pour toutes les commandes sauf pour des articles qui sont en stock et qui sont envoyés dans les 3 jours suivant la commande.

Annulation de commande

Les bons d'achat pour les produits faits sur commande ne peuvent pas être annulés.

Conditions

Comptes créditeurs approuvés: 30 jours à partir de la fin du mois de facturation.

Reglements De L'etranger

Nous pouvons gérer votre compte dans l'une des différentes devises qui vous sont proposées; veuillez convenir de votre choix avec le responsable des ventes lors de votre première commande. Veuillez faire en sorte que votre règlement, dans la devise choisie, nous parvienne dans sa totalité sans déductions de frais.

Renvois

Les clients qui désirent renvoyer des marchandises pour quelque raison que ce soit doivent tout d'abord contacter notre service administratif des ventes, car autrement le renvoi risque de s'effectuer avec des retards considérables.

Spécifications

Comme partie intégrante de ses efforts continus pour offrir la toute dernière technologie en matière de composants à quartz à ses clients, IQD se réserve le droit de changer les spécifications, les styles et les modèles sans préavis.

Modalites Type

Toute commande est acceptée sous réserve de disponibilité des matériaux de fabrication; nous nous réservons le droit de réviser les prix en fonction des fluctuations des taux de change internationaux. La propriété des marchandises qui font l'objet d'une commande n'est transférée à l'acheteur qu'après réception du règlement. Aucun contrat pour la fourniture de marchandises fabriquées sur mesure ne peut être annulé après le début de la fabrication. Les conditions de paiement sont exactement de 30 jours à partir du mois de facturation pour les comptes créditeurs approuvés. En cas de facture impayée au terme des délais de paiement agréés, toutes les autres factures impayées deviennent immédiatement payables et toutes les commandes en attente pour des articles fabriqués sur mesure doivent être réglées dans leur intégralité. Un taux d'intérêt composé mensuel de 2% est appliqué pour les factures en retard. La législation anglaise est la seule valable.

INFORMAZIONI PER L'ORDINAZIONE

PROFILO AZIENDALE

La IQD Limited è specializzata nella produzione di cristalli di quarzo e prodotti affini. Dalla sua costituzione, nel 1974, questo nome è diventato sinonimo della migliore qualità e assistenza nell'ambito dell'industria dei cristalli.

La IQD, la cui sede è nel sudovest dell'Inghilterra, produce componenti di cristallo per i principali produttori di apparecchiature originali (OEM) di tutto il mondo. I componenti IQD sono utilizzati in tutti i settori dell'alta tecnologia, tra cui i settori aerospaziale, automobilistico, spaziale, satelliti, computer e comunicazioni, con prodotti assai diversi, come sottomarini nucleari e televisione.

Dai prodotti di tipo commerciale a basso costo ai più rigorosi requisiti delle applicazioni a scopo militare e professionale, la IQD mantiene l'eccellente qualità che la distingue. Questa promessa di qualità è consolidata dalla ratifica delle norme sulla qualità BS5750, BS9000, EN29002, ISO9002 e CECC68000.

La gamma di prodotti copre tutti gli aspetti dei cristalli di quarzo, oscillatori a quarzo piezoelettrico e filtri piezo-elettrici. Vengono prodotti anche risonatori e filtri ceramici, contenitori del cristallo piezoelettrico e fermagli.

Mediante strette consultazioni con i clienti, la IQD offre totale appoggio nelle applicazioni, dalla fase di progettazione iniziale alla produzione globale.

I nostri esperti tecnici delle vendite sono appoggiati da un sofisticato sistema informatico con terminali multipli per il trattamento di ogni aspetto dell'attività, compresa la pianificazione a termine di vendite, acquisti e stock, e la progettazione assistita da elaboratore.

La capacità della IQD di soddisfare i clienti che richiedono urgenti consegne è insuperata. Con uno dei più vasti stock d'Europa per prodotti di cristallo, ed un rapido servizio per articoli fatti su ordinazione, in grado di realizzare frequenze non in magazzino in soli 3 giorni, possiamo far fronte alla maggior parte delle richieste più urgenti.

Sono disponibili speciali impianti di prova, tra cui completi programmi di invecchiamento preventivo di cristalli ed oscillatori, ed il collaudo di oscillatori per applicazioni militari in conformità alle norme MIL 55310.

INFORMAZIONI PER L'ORDINAZIONE

Orario d'ufficio

9-17, da lunedì a venerdì, salvo nelle feste nazionali UK.

Spese per minime ordinazioni

Ordini in conto: Lg.25; con pagamento anticipato: Lg.25.

Preventivi

I preventivi redatti dalla IQD sono validi 4 settimane, salvo indicazione al contrario.

Certificato di conformità

Il certificato di conformità è fornito a richiesta per ordini confermati per iscritto o a mezzo facsimile, telex o lettera.

Conferma d'ordine

La conferma d'ordine viene spedita per tutte le ordinazioni salvo per gli articoli ex-stock spediti entro 3 gg dall'ordine.

Annullamento di un ordine

Gli ordini d'acquisto per articoli prodotti su ordinazione non sono annullabili.

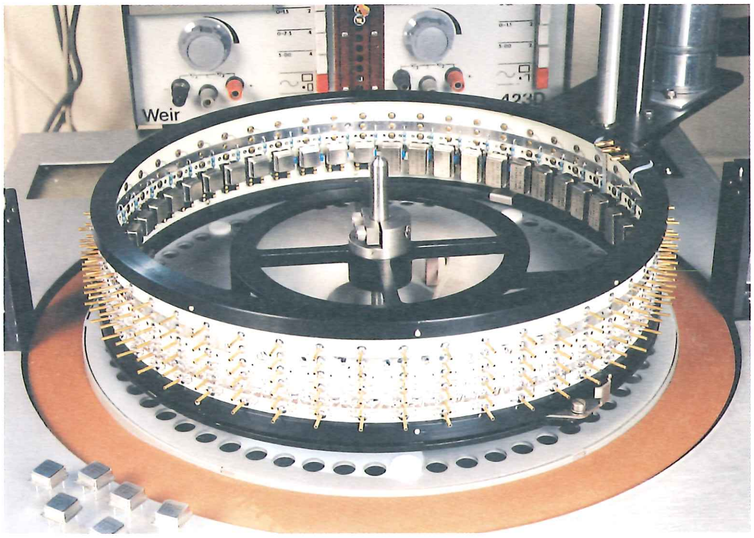
Spedizione

Gli ordini per articoli ex-stock, ricevuti entro le ore 16, sono solitamente spediti lo stesso giorno se specificamente richiesto in sede di ordinazione.

Condizioni

30 giorni dalla fine del mese in cui è stata emessa la fattura, per i conti di credito approvati.

Testing oscillators over their operating temperature range with a computer controlled test oven



Pagamenti Dall'estero

Possiamo operare un conto per voi in una qualsiasi fra le diverse valute disponibili; siete pregati di prendere accordi su ciò con il venditore quando piazzate il primo ordine. Siete pregati di assicurarvi che ci pervenga la rimessa, nella valuta concordata, dell'importo totale, senza detrazioni od oneri.

Resa

I clienti che desiderano rendere la merce, per qualsiasi motivo, devono prima contattare il nostro ufficio vendite; diversamente la procedura di restituzione potrebbe protrarsi a lungo.

Specifiche

La IQD adotta una politica che la impegna ad offrire ai propri clienti la più moderna tecnologia dei componenti di cristallo, pertanto si riserva il diritto di apportare modifiche a specifiche, design e modelli senza preavviso.

Condizioni Generali

L'accettazione di un ordine è soggetta alla disponibilit à dei materiali per la produzione; ci riserviamo il diritto di variare i prezzi a causa delle fluttuazioni dei tassi di cambio internazionali. La proprietà dei beni che sono oggetto di un ordine non passerà all'acquirente fino a ché non sia stato ricevuto il pagamento effettivo. Non è possibile in alcun caso cancellare un contratto per la fornitura di articoli fatti su misura, una volta che sia iniziata la produzione. Le condizioni di pagamento sono rigorosamente 30 giorni dalla fine del mese in cui è stata emessa la fattura, per i conti di credito approvati. Se una qualsiasi fattura rimane insoluta oltre il limite delle condizioni concordate, tutte le altre fatture pendenti diverranno immediatamente pagabili e sarà dovuto l'intero pagamento per qualsiasi ordine inevaso di articoli fatti su misura. Verranno addebitati interessi composti al 2% mensile sulle fatture insolute. L'unica legge applicabile sarà quella inglese.

Part of our large stores area stocking approximately 500,000 crystals and 100,000 oscillators

CERAMIC RESONATORS - Section Contents

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STOCK CERAMIC RESONATORS

Frequency	Model	Stock No.
455.0kHz	IQC-20	K253F
640.0kHz	IQC-20	K256F
800.0kHz	IQC-20	K259F
2.0MHz	IQC-32	K209A
2.0MHz	IQC-20	K196F
3580.0kHz	IQC-20	K200F
3580.0kHz	IQC-32	K200A
4.0MHz	IQC-20	K201F
4.0MHz	IQC-32	K201A
4190.0kHz	IQC-20	K198F
4190.0kHz	IQC-32	K198A
5.0MHz	IQC-20	K202F
6.0MHz	IQC-20	K203F
6.0MHz	IQC-32	K203A
8.0MHz	IQC-32	K204A
10.0MHz	IQC-32	K197A
11.0MHz	IQC-32	K205A
12.0MHz	IQC-32	K206A
16.0MHz	IQC-32	K207A
20.0MHz	IQC-32	K208A

MTO CERAMIC RESONATORS - Delivery Options

Low Frequency Ceramic Resonators

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
190.0 to 379.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-20	2 to 12 weeks	4
	±5000ppm (±0.5%)			IQC-30		10
380.0 to 640.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-20		4
				IQC-21		6
	±5000ppm (±0.5%)			IQC-30		10
641.0 to 655.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-20		4
	±5000ppm (±0.5%)			IQC-30		10
				IQC-20		4
656.0 to 680.kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-20		4
				IQC-30		10
680.0 to 830.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-20		4
795.0 to 1020.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-31		12

High Frequency Ceramic Resonators

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
2.0 to 6.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-22	2 to 12 weeks	8
				IQC-32		14
6.1 to 20.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-32		

IQC-20 CERAMIC RESONATORS 190 to 830kHz

ISSUE 1; 23 AUGUST 1993

Holder Style

- Ceramic element in plastic case

General Specifications

- Load Capacitance (C_L): dependant on frequency range, see test circuit
- Long Term Aging: ±5000ppm (±0.5%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

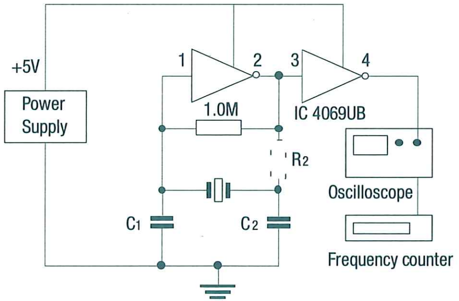
Standard Storage Temperature Range

- –40 to 85°C

Marking

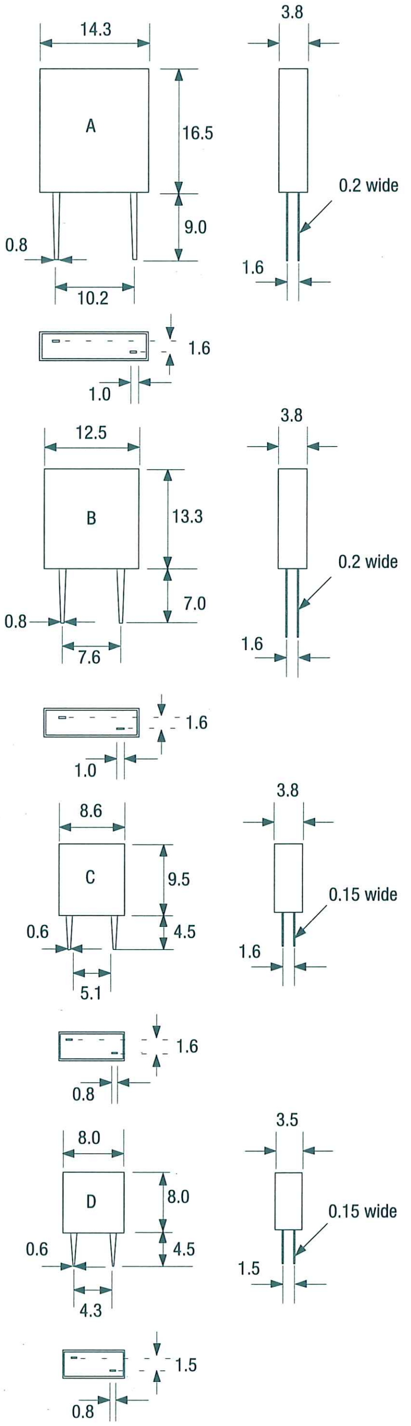
- Printed on resonator surface, includes frequency

Test Circuit



Frequency	C1	C2	R2
190.0 to 249.999kHz	330pF	470pF	--
250.0 to 379.999kHz	220pF	470pF	--
380.0 to 429.999kHz	120pF	470pF	--
430.0 to 640.999kHz	100pF	100pF	--
641.0 to 830.000kHz	100pF	100pF	5k6

Outline - Case types A, B, C & D



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode	Case Type
190.0 to 249.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	A
250.0 to 379.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	B
380.0 to 439.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	C
440.0 to 529.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	D
530.0 to 640.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	30Ω	Fundamental	D
641.0 to 830.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	50Ω	Fundamental	D

IQC-21 CERAMIC RESONATORS 340 to 640kHz

ISSUE 1; 27 AUGUST 1993

Holder Style

- Ceramic element in plastic case

General Specifications

- Load Capacitance (C_L): dependant on frequency range, see test circuit
- Long Term Aging: ±5000ppm (±0.5%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

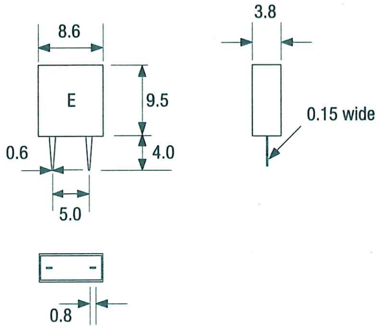
Standard Storage Temperature Range

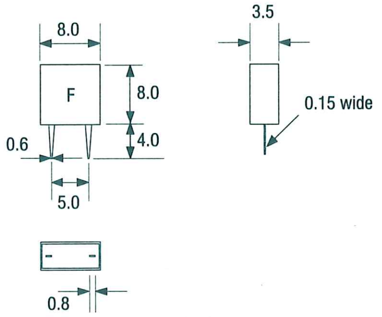
- –40 to 85°C

Marking

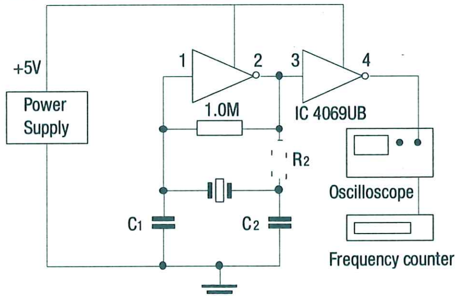
- Printed on resonator surface, includes frequency

Outline - Case types E & F





Test Circuit



Frequency	C_1	C_2	R_2
190.0 to 249.999kHz	330pF	470pF	--
250.0 to 379.999kHz	220pF	470pF	--
380.0 to 429.999kHz	120pF	470pF	--
430.0 to 640.999kHz	100pF	100pF	--
641.0 to 830.000kHz	100pF	100pF	5k6

Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode	Case Type
380.0 to 439.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	E
440.0 to 529.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	F
530.0 to 640.999kHz	±3000ppm (±0.3%)	±3000ppm (±0.3%)	–20 to 80°C	30Ω	Fundamental	F

IQC-22 CERAMIC RESONATORS 2.0 to 6.0MHz

ISSUE 1; 27 AUGUST 1993

Holder Style

- Ceramic element dipped in epoxy resin

General Specifications

- Load Capacitance (C_L): 30pF
- Long Term Aging: ±5000ppm (±0.5%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

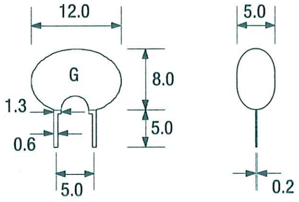
Standard Storage Temperature Range

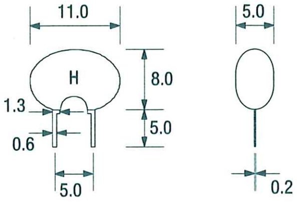
- –40 to 85°C

Marking

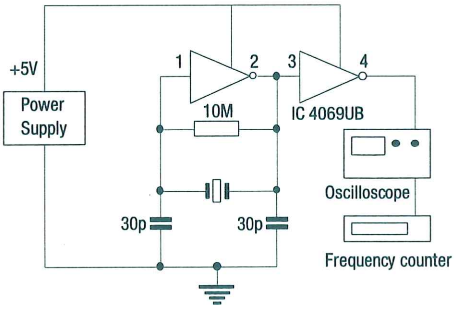
Printed on resonator surface, includes frequency

Outline - Case types G & H





Test Circuit



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode	Case Type
2.0 to 3.40MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	100Ω	Fundamental	G
3.41 to 6.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	30Ω	Fundamental	H

IQC-30 CERAMIC RESONATORS 190 to 680.0kHz

ISSUE 1; 31 AUGUST 1993

Holder Style

- Ceramic element in plastic case

General Specifications

- Load Capacitance (C_L): 30pF
- Long Term Aging: ±5000ppm (±0.5%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

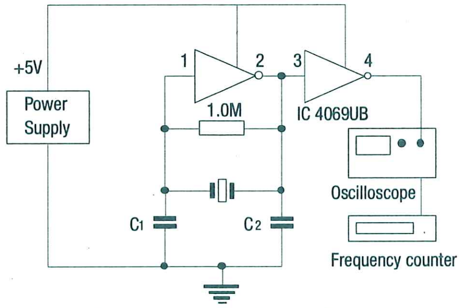
Standard Storage Temperature Range

- –40 to 85°C

Marking

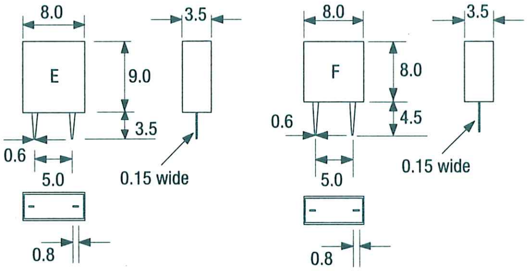
- Printed on resonator surface, includes frequency

Test Circuit

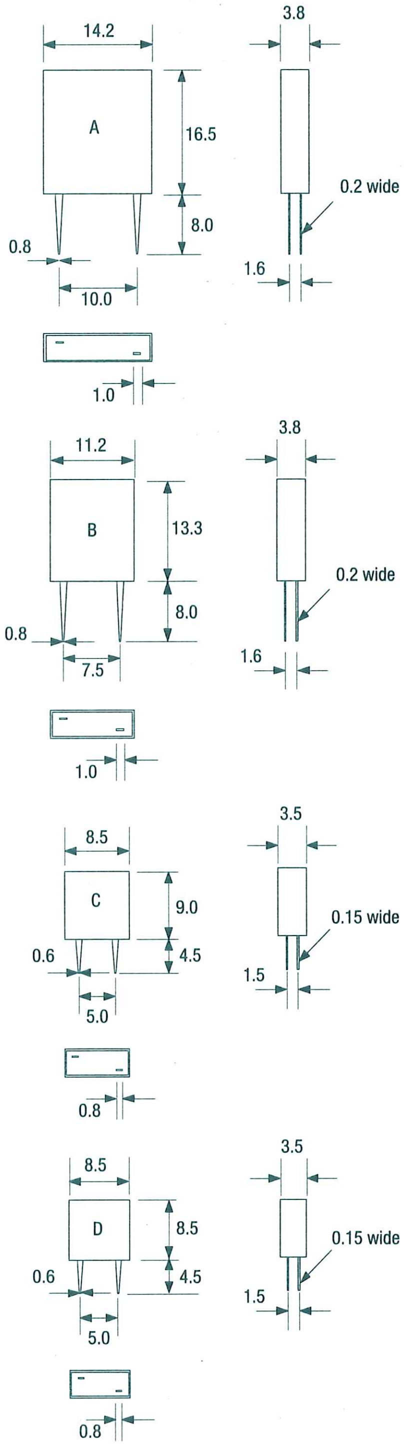


Frequency	C_1	C_2
190 to 249.999kHz	330pF	470pF
250 to 379.999kHz	220pF	470pF
380 to 439.999kHz	100pF	470pF
440 to 680kHz	100pF	100pF

Outline - Case types E & F



Outline - Case types A, B, C & D



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode	Case Type
190.0 to 249.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	A
250.0 to 379.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	B
380.0 to 430.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	C
431.0 to 439.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	D
440.0 to 525.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	E
526.0 to 539.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	F
540.0 to 599.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	20Ω	Fundamental	E
600.0 to 655.999kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	50Ω	Fundamental	E
656.0 to 680.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	50Ω	Fundamental	F

IQC-31 CERAMIC RESONATORS 795.0 to 1020.0kHz

ISSUE 1; 3 SEPTEMBER 1993

Holder Style

- Ceramic element in plastic case

General Specifications

- Load Capacitance (C_L): 100pF
- Long Term Aging: ±5000ppm (±0.5%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

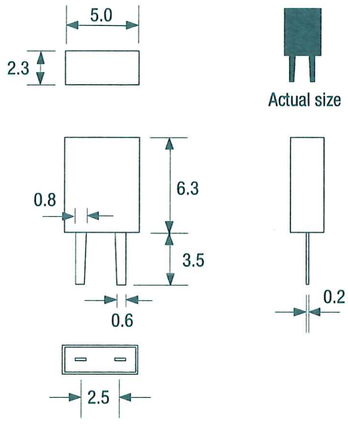
Standard Storage Temperature Range

- –40 to 85°C

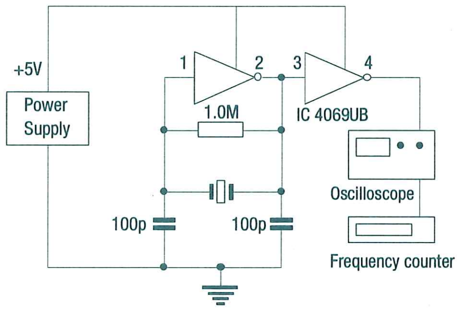
Marking

- Printed on resonator surface, includes frequency

Outline (scale 2:1)



Test Circuit



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
795.0 to 815.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	70Ω	Fundamental
960.0 to 1020.0kHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	100Ω	Fundamental

IQC-32 CERAMIC RESONATORS 2.0 to 20.0MHz

ISSUE 1; 3 SEPTEMBER 1993

Holder Style

- Ceramic element dipped in epoxy resin

General Specifications

- Load Capacitance (C_L): 33pF
- Long Term Aging: ±3000ppm (±0.3%) over 10 years @ 25°C

Standard Operating Temperature Range

- –20 to 80°C

Standard Storage Temperature Range

- –30 to 85°C

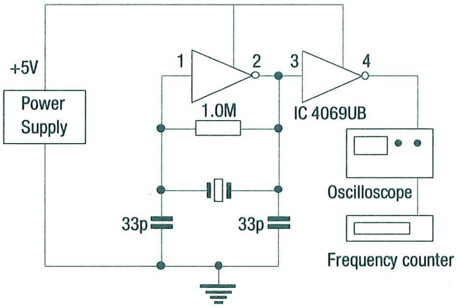
Packaging

- IQC-32 ceramic resonators are available packaged individually or on tape and reel with a maximum of 2000 pieces per reel. Tape and reel dimensions for each size of resonator are available on request

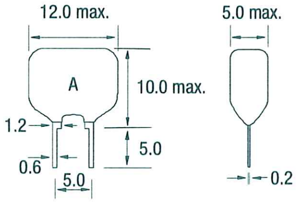
Marking

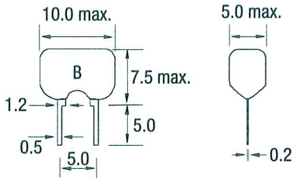
- Printed on resonator surface, includes frequency and date code

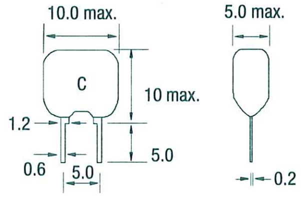
Test Circuit

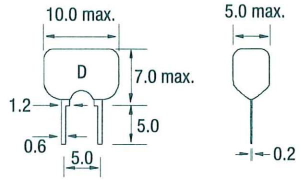


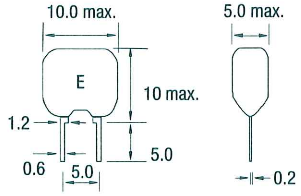
Outline - Case types A, B, C, D & E











Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode	Case Type
2.0 to 3.5MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	100Ω	Fundamental	A
3.58 to 6.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	30Ω	Fundamental	B
6.1 to 6.999MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	40Ω	Fundamental	C
7.0 to 12.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	40Ω	Fundamental	D
12.1 to 20.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	30Ω	Fundamental	E

QUARTZ CRYSTALS - Section Contents

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CX1 Crystals 10.0kHz to 2.0MHz. 32

CX1 Crystals 8.0 to 32.0MHz 34

HC35 (TO5) Crystals 8.0 to 210.0MHz 36

UM1 (HC45) Crystals 950.0kHz to 250.0MHz. 38

UM5 Crystals 10.0 to 175.0MHz 40

HC49/4H Crystals 3 to 60MHz. 42

HC49 (HC43) Crystals 400kHz to 322MHz 44

HC51 & HC47 Crystals 160kHz to 50MHz. 47

SPECIFYING QUARTZ CRYSTALS

A typical quartz crystal specification reads like this:

16.66667MHz HC49 20 30 10 30

Frequency

Holder Style

Frequency Tolerance at 25°C

Frequency Stability

Lower end of Temperature Range

Circuit Condition

The following notes to each element of the specification in turn show how to arrive at a specification that will fully describe the crystal you require.

Frequency

Frequency is normally specified in Kilohertz (kHz) up to 9999.999kHz and in Megahertz (MHz) from 10.0MHz upwards except for integer values which are all specified in MHz. All our computer-generated transaction documents follow this standard convention automatically.

Most crystals are capable of adjustment to within less than 10 parts per million (ppm)of nominal frequency during manufacture, so the frequency should be described to seven significant figures. If seven significant figures are not used, we assume that any figure that might follow those given may be taken as zero. Thus a frequency given as 16.6MHz will be taken as 16.60, not 16.66667 as would be intended, and should be specified, if what you want is 50 divided by 3.

Some specifiers extend the use of kHz to all crystals operating in fundamental mode, reserving MHz for overtones. To minimise the possibility of misunderstanding it is best to use the standard method and specify fundamental or overtone mode separately if this is important to the application.

Holder Style

The American military nomenclature is widely used for describing crystal holders. If the can size is not known or is unimportant we will supply the holder normally adopted for the frequency specified, such as HC49 for the majority of microprocessor applications.

Frequency Tolerance

The cost of manufacture depends partly on the accuracy required at ambient temperature (which in the case of the AT-cut crystal, is usually 25°C).

Where accuracy is important (such as in a timepiece) the cost of manufacturing accuracy of the crystal should be balanced against the cost and inconvenience of provision for adjustment of the frequency after installation.

Frequency Stability

Frequency stability is normally specified as a ± value measured over a defined temperature range. The temperature ranges are defined for each crystal in the relevant data sheet. However the majority of crystals will continue to operate quite satisfactorily outside the temperature range for which they are specified, but with a degredation in the value of frequency stability. Under normal conditions this will not damage the crystal.

A crystal designed for operation over a restricted temperature range (such as from 0 to 50 degrees C) has a better frequency stability over that range than one designed for operation over a wide temperature range will have when used over a restricted range. Therefore it is important not to over-specify the temperature range, as doing so will result in inferior performance for the same or greater cost; or greater cost for the same or inferior performance.

Temperature Range

The operating temperature range of a crystal can be any one of the following ranges:

0 to 50°C
–10 to 60°C
–20 to 70°C
–30 to 80°C
–40 to 90°C
–55 to 105°C
–55 to 125°C

When the required range has been selected the lower figure for temperature in each range is used to indicate the correct range. If the range –10 to 60°C had been selected the specification would read '10' as shown in the example. If the full military temperature range (–55 to 125°C) is selected, an 'M' should be used instead of '55' to distinguish it from the -55 to 105°C range.

For ovened operation, this figure denotes the oven temperature, for example '80' for 80°C operation.

Circuit condition

If the crystal is to be used in series mode, the last character in the specification is 'S' to denote this mode.

If it is to be used in parallel mode, the last character represents the capacitance of the circuit in which it is to be connected. This may typically be 30pf.

Outline Drawings

Dimensions on the crystal outline drawings are shown only as a guide. Precise dimensions of crystal holders are available from our factory upon request. All dimensions are shown in mm and are nominal unless otherwise stated. All outlines are at a scale of 1:1 unless otherwise specified.

Standard Frequency Tolerances and Stabilities

- ±2.5ppm, ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
- –10 to 60°C
- –20 to 70°C
- –30 to 80°C
- –40 to 90°C
- –55 to 105°C
- –55 to 125°C

Delivery Options

The following delivery options are available for crystals; timescales refer to despatch from our UK factory. Prices for larger quantities and longer delivery times are lower due to substantially reduced manufacturing costs.

- 3 working days (Express service)
- 5 working days (Express service)
- 7 working days (Express service)
- 10 working days (Express service)
- 3 to 4 weeks (Standard service)
- 6 weeks (Low cost service)
- 10 to 12 weeks (Low cost service)

Minimum Order Information Required

- Holder + Frequency + Load Capacitance (circuit condition)

Additional Order Information Where Applicable

- Frequency Tolerance + Frequency Stability + Operating Temperature Range

Stability Conversion Chart

10^{X}	PPM	%
10^{-3}	1000	0.1
10^{-4}	100	0.01
10^{-5}	10	0.001
10^{-6}	1	0.0001
10^{-7}	0.1	0.00001
10^{-8}	0.01	0.000001
10^{-9}	0.001	0.0000001
10^{-10}	0.0001	0.00000001

STOCK QUARTZ CRYSTALS

WATCH CRYSTALS

Frequency	Holder	Specification	Stock No.
32.7680kHz	3x8mm	20/-/-/12.5	A103A
32.7680kHz	3x8mm	15/-/-/12.5	A103B
32.7680kHz	2x6mm	20/-/-/12.5	A103C
See Quartz-Check watch crystal timer on page 28			

MINIATURE CYLINDRICAL CRYSTALS

Frequency	Holder	Specification	Stock No.
40.0kHz	3x8mm min cyl	30/-/-/12.5	A109A
100.0kHz	3x8mm min cyl	100/-/-/12.5	A104F
3579.545kHz	3x8mm min cyl	30/50/10/20	A119G
4.0MHz	3x8mm min cyl	20/50/10/30	A120G
4194.304kHz	3x8mm min cyl	20/30/10/20	A123G
4433.619kHz	3x8mm min cyl	20/30/10/20	A124G
4915.20kHz	3x8mm min cyl	20/50/10/30	A127G
11.05920MHz	3x8mm min cyl	30/50/10/20	L108G

ULTRA MINIATURE CX TYPE CRYSTALS

10.0kHz	CX1V	30/180/40/9	C101A
15.360kHz	CX1V	30/180/40/9	C103A
16.0kHz	CX1V	30/180/40/9	C104A
20.480kHz	CX1V	30/180/40/9	C108A
30.720kHz	CX1V	30/180/40/9	C111A
32.7680kHz	CX1V	30/180/40/9	C113A
32.7680kHz	CX1V	10000/180/40/9	C213A
32.7680kHz	CX1H	30/180/40/9	C313A
38.40kHz	CX1V	30/180/40/9	C114A
40.0kHz	CX1V	10000/180/40/9	C226A
40.960kHz	CX1V	30/180/40/9	C115A
60.0kHz	CX1V	10000/180/40/9	C216A
76.80kHz	CX1V	30/180/40/9	C117A
100.0kHz	CX1H	10000/180/40/9	C418A
153.60kHz	CX1V	50/180/40/4	C119A
153.60kHz	CX1H	10000/180/40/9	C419A
240.0kHz	CX1H	100/180/40/4	C320A
307.20kHz	CX1V	100/180/40/4	C121A
1.0MHz	CX1V	500/180/40/10	C127A
1008.0kHz	CX1V	500/180/40/10	C128A
2.0MHz	CX1V	500/180/40/10	C134A

HC49/4H & HC49/5H CRYSTALS

Frequency	Holder	Specification	Stock No.
3276.80kHz	HC49/4H	50/50/10/12	A118C
3579.545kHz	HC49/4H	30/50/20/20	A119K
3686.40kHz	HC49/4H	30/50/20/30	A169K
4.0MHz	HC49/4H	20/50/10/30	A120K
4096.0kHz	HC49/4H	30/50/10/30	A122K
4194.304kHz	HC49/4H	30/50/10/12	A123K
4433.619kHz	HC49/4H	30/50/10/20	A124K
4608.0kHz	HC49/4H	30/50/10/30	A125K
4915.20kHz	HC49/4H	30/50/20/30	A127K
5068.80kHz	HC49/4H	30/50/10/S	A129K
5760.0kHz	HC49/4H	30/50/10/30	L102K
6.0MHz	HC49/4H	30/50/10/30	A132K
6144.0kHz	HC49/4H	30/50/10/30	A133K
7372.80kHz	HC49/4H	30/50/10/30	A194K
7372.80kHz	HC49/4H	15/30/10/18	A194L
7864.320kHz	HC49/4H	50/100/10/30	A139A
8.0MHz	HC49/4H	30/50/20/30	A140K
8192.0kHz	HC49/4H	30/50/10/30	A170K
9830.40kHz	HC49/4H	30/50/10/30	A173K
10.0MHz	HC49/4H	30/50/20/30	A143K
10.7520MHz	HC49/4H	30/50/10/30	A212K
11.05920MHz	HC49/4H	30/50/20/30	L108K
12.0MHz	HC49/4H	30/50/20/30	A158K
12.2880MHz	HC49/4H	30/50/10/30	A175K
14.31818MHz	HC49/4H	30/50/10/S	A153K
14.31818MHz	HC49/4H	30/50/20/30	A153L
14.74560MHz	HC49/4H	30/50/10/30	A159K
15.0MHz	HC49/4H	30/50/10/30	A160K
16.0MHz	HC49/4H	30/50/20/30	A161K
16.1280MHz	HC49/4H	30/50/20/30	A206K
16.9344MHz	HC49/4H	30/50/10/30	A213K
18.4320MHz	HC49/4H	30/50/20/30	A146K
19.66080MHz	HC49/4H	30/50/10/30	A182K
20.0MHz	HC49/4H	30/50/20/12	A147K
24.0MHz	HC49/4H	30/50/10/30 Fund	A189K
24.00014MHz	HC49/4H	15/30/10/18 Fund	A210K
27.0MHz	HC49/5H	20/50/10/S	A196K
32.0MHz	HC49/4H	30/50/20/S	A166K
35.2512MHz	HC49/4H	15/30/20/18	A216K
40.0MHz	HC49/4H	30/50/20/S	A209K

HC45 & UM1 CRYSTALS

Frequency	Holder	Specification	Stock No.
1.0MHz	UM-1	200/100/10/30	A111F
3579.545kHz	UM-1	20/50/10/20	A119J
8.0MHz	UM-1	20/30/10/30	A140H
8192.0kHz	UM-1	20/30/10/30	A170H

8192.0kHz	UM-1	20/30/10/20	A170J
9600.0kHz	UM-1	20/30/10/30	A172H
9830.4kHz	UM-1	20/30/10/30	A173H
10.0MHz	UM-1	20/30/10/20	A143J
10.2450MHz	UM-1	20/30/10/30	A155H
11.05920MHz	UM-1	20/30/10/30	L108H
12.0MHz	UM-1	20/30/10/30	A158H
12.2880MHz	UM-1	20/30/10/30	A175H
14.31818MHz	UM-1	20/30/10/20	A153J
14.74560MHz	UM-1	20/30/10/30	A159H
16.0MHz	UM-1	20/30/10/30	A161H
16.3840MHz	UM-1	20/30/10/30	A178H
17.73447MHz	UM-1	20/30/10/20	A180J
19.66080MHz	UM-1	20/30/10/20	A182J
19.66080MHz	UM-1	20/30/10/30	A182H
20.0MHz	UM-1	20/30/10/30	A147H
20.0MHz	UM-1	20/30/10/20	A147J
24.0MHz	UM-1	20/30/10/30	A189H
29.49120MHz	UM-1	30/50/10/12	A311A
32.0MHz	UM-1	20/30/10/S	A166H

HC43/T & HC49/T CRYSTALS

Frequency	Holder	Specification	Stock No.
1.0MHz	HC49/T	500/500/0/30	A111T
1.0MHz	HC43/T	500/500/0/30	A111E

HC49 (HC43, HC18) CRYSTALS

Frequency	Holder	Specification	Stock No.
1.0MHz	HC49	50/100/10/30	A111L
1843.20kHz	HC49	20/50/10/30	A113B
1843.20kHz	HC49	20/50/10/S	A113C
2.0MHz	HC49	50/100/0/20	A114E
2097.152kHz	HC49	20/50/10/30	A115E
2457.60kHz	HC49	20/50/10/30	A116C
2500.0kHz	HC49	20/50/10/50	A168B
2562.50kHz	HC49	20/50/10/30	A117A
2583.0kHz	HC49	20/50/10/S	A200B
3.0MHz	HC49	20/50/10/30	A150B
3276.80kHz	HC49	20/30/10/12	A118B
3579.545kHz	HC49	20/50/10/20	A119C
3686.40kHz	HC49	20/50/10/30	A169A
3993.6kHz	HC49	20/30/10/20	A211A
4.0MHz	HC49	20/10/20/30	A120A
4.0MHz	HC49	20/50/10/30	A120B
4032.0kHz	HC49	20/10/20/30	A121A
4096.0kHz	HC49	20/10/20/30	A122A
4096.0kHz	HC49	20/50/10/30	A122B
4194.304kHz	HC49	20/30/10/12	A123A
4194.304kHz	HC49	50/50/30/20	A123L
4433.619kHz	HC49	20/30/10/20	A124D
4608.0kHz	HC49	20/10/20/30	A125A
4608.0kHz	HC49	20/50/10/30	A125C
4800.0kHz	HC49	20/10/20/30	A126A
4915.20kHz	HC49	20/50/10/30	A127A
5.0MHz	HC49	20/10/20/30	A128A
5.0MHz	HC49	20/50/10/30	A128B
5068.80kHz	HC49	20/50/10/S	A129A
5120.0kHz	HC49	20/10/20/30	A130A
5242.880kHz	HC49	20/30/10/12	A186A
5529.60kHz	HC49	30/50/20/20	A215A
6.0MHz	HC49	20/50/10/30	A132A
6144.0kHz	HC49	20/50/10/30	A133A
6400.0kHz	HC49	20/30/10/30	A134B
6553.60kHz	HC49	20/30/10/12	A135A
7159.090kHz	HC49	20/50/10/20	A217A
7168.0kHz	HC49	20/30/10/30	A137A
7372.80kHz	HC49	20/50/10/30	A194A
7372.80kHz	HC49	20/50/10/S	A194B
7680.0kHz	HC49	20/50/10/30	A138A
8.0MHz	HC49	20/50/10/30	A140A
8192.0kHz	HC49	20/50/10/30	A170A
8388.608kHz	HC49	20/50/10/30	A141A
8867.237kHz	HC49	30/30/10/20	A154A
9.0MHz	HC49	20/30/10/30	A164A
9216.0kHz	HC49	20/50/10/30	A205A
9830.40kHz	HC49	20/50/10/30	A173A
10.0MHz	HC49	20/10/20/30	A143A
10.0MHz	HC49	20/50/10/30	A143E
10.2450MHz	HC49	20/30/10/30	A155B
10.70MHz	HC49	20/50/10/30	A144A
10.73864MHz	HC49	20/30/10/30	A305A
10.7520MHz	HC49	20/30/10/30	A212A
11.0MHz	HC49	20/30/10/30	A193A
11.0MHz	HC49	20/50/10/S	A193B
11.05920MHz	HC49	20/30/10/20	L108A
11.05920MHz	HC49	20/30/10/30	L108C
11.28960MHz	HC49	20/30/10/30	A214A
12.0MHz	HC49	20/30/10/30	A158A
12.2880MHz	HC49	20/30/10/30	A175A
12.2880MHz	HC49	20/50/10/S	A175B
14.0MHz	HC49	20/50/10/30	A195A
14.31818MHz	HC49	20/50/10/S	A153A
14.74560MHz	HC49	20/30/10/30	A159A
14.74560MHz	HC49	20/50/10/S	A159B
15.0MHz	HC49	20/50/10/S	A160C

Frequency	Holder	Specification	Stock No.
16.0MHz	HC49	20/30/10/30	A161A
16.0MHz	HC49	20/50/10/S	A161C
16.1280MHz	HC49	20/50/10/30	A206A
16.3840MHz	HC49	20/30/10/30	A178A
17.73447MHz	HC49	20/30/10/30	A180A
17.73447MHz	HC49	20/30/10/10	E501A
18.0MHz	HC49	20/50/10/S	A145B
18.4320MHz	HC49	20/50/10/S	A146B
18.4320MHz	HC49	40/40/10/10	E120A
19.66080MHz	HC49	20/50/10/S	A182A
20.0MHz	HC49	20/50/10/30	A147A
20.0MHz	HC49	20/30/10/S	A147C
22.11840MHz	HC49	20/50/10/S	A183A
24.0MHz	HC49	20/50/10/S Fund	A189A
24.00014MHz	HC49	15/30/10/18 Fund	A210A
25.0MHz	HC49	20/50/10/S Fund	A187B
27.6480MHz	HC49	20/50/10/S	A185A
29.49120MHz	HC49	20/50/10/30	A311B
30.0MHz	HC49	20/50/10/S Fund	A197B
32.0MHz	HC49	20/30/10/S	A166A
60.0MHz	HC49	20/30/10/S	A198A
64.0MHz	HC49	20/50/10/S	A199A
100.0MHz	HC49	20/30/10/S	A149A
173.2250MHz	HC49	20/50/10/S	A307A

HC51, HC48, HC6 & HC33 CRYSTALS

Frequency	Holder	Specification	Stock No.
200.0kHz	HC6	-/100/0/30	A105A
204.80kHz	HC48	-/100/0/30	A106Z
307.20kHz	HC6	-/100/0/S	A108A
307.20kHz	HC33	-/100/0/S	A108B
307.20kHz	HC33	-/100/0/30	A108C
1.0MHz	HC51	50/50/0/30	A111B
1843.20kHz	HC51	20/50/0/13	A113A
1843.20kHz	HC33	20/50/10/30	A113R
2.0MHz	HC51	20/50/10/30	A114D
2097.152kHz	HC51	20/50/10/12	A115C
2457.60kHz	HC33	20/50/10/30	A116A
2457.60kHz	HC33	20/50/10/S	A116D
2500.0kHz	HC33	20/50/10/50	A168A
2562.50kHz	HC33	20/50/10/S	A117B
2583.0kHz	HC33	20/50/10/S	A200A
3276.80kHz	HC33	20/30/10/12	A118A

Made-to-Order QUARTZ CRYSTALS - Delivery Options

Watch Crystals

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
32.768kHz	±10ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C	8 to 12 weeks	27
		±40ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±70ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		

Miniature Cylinder (2 x 6)

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
10.0 to 200.0kHz	±30ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	8 to 12 weeks	29
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		

Miniature Cylinder (3 x 8)

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
15kHz to 150kHz	±20ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	8 to 12 weeks	30
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		
350kHz to 1.536MHz	±50ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C		
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		
1.7 to 2.699MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
3.57 to 60.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C		
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		

CX1

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
10.0 to 74.999kHz	±30 to ±10,000ppm	–90ppm	–10 to 70°C	2 to 12 weeks	32
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
75.0 to 200.999kHz	±50 to ±10,000ppm	–90ppm	–10 to 70°C		
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
201.0kHz to 2.0MHz	±100 to ±10,000ppm	–90ppm	–10 to 70°C		
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
8.0 to 32.0MHz	±50 to ±1,000ppm	±30ppm	–10 to 70°C		34
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
Please note that higher frequencies are available upon request; please contact our sales office.					

HC35 (TO5)

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
8.0 to 210.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	3 days to 12 weeks	36
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

UM1 (HC45)

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
950.0kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	4 to 12 weeks	38
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
6.0 to 250.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	3 days to 12 weeks	
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

UM5

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
10.0 to 15.999MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –10 to 60°C	8 to 12 weeks	40
16.0 to 29.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	3 days to 12 weeks	
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
30.0 to 40.0MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	10 to 12 weeks	
40.0 to 175.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	3 days to 12 weeks	
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		

HC49/4H

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
3.0 to 7.999MHz	±20ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	6 to 12 weeks	42
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
8.0 to 11.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C		
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
12.0 to 25.0MHz	±20ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	10 days to 12 weeks	
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
25.0 to 40.0MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C	6 to 12 weeks	
		±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±80ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
25.0 to 60.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C		
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		

HC49, HC43, HC50, HC42, HC49/T & HC43/T

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
400kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	4 to 12 weeks	44
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
1.6 to 30.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	3 days to 12 weeks	
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
18.0 to 46.0MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
55.0 to 322MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
21.0 to 270.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

HC51, HC47, HC48 & HC36

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
160kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	10 to 12 weeks	47
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
890kHz to 50.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	3 days to 12 weeks	
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

WATCH CRYSTALS 32.768kHz

ISSUE 4; 21 MARCH 1994

Holder Style

- Watch crystals are press sealed. Four sizes are available: 3 x 8.2mm, 2 x 6mm, 1.5 x 5.1mm & 1.05 x 4.45mm

General Specifications

- Load Capacitance (C_L): 3pf to 15pf
- Drive Level: 1µW max
- Shunt Capacitance (C_O): 1.6pf typical

Standard Frequency Tolerances and Stabilities

- ±20ppm, ±30ppm, ±50ppm, ±70ppm, ±100ppm

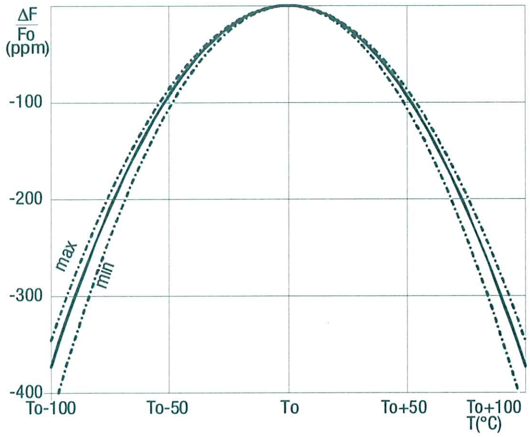
Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C

Standard Storage Temperature Range

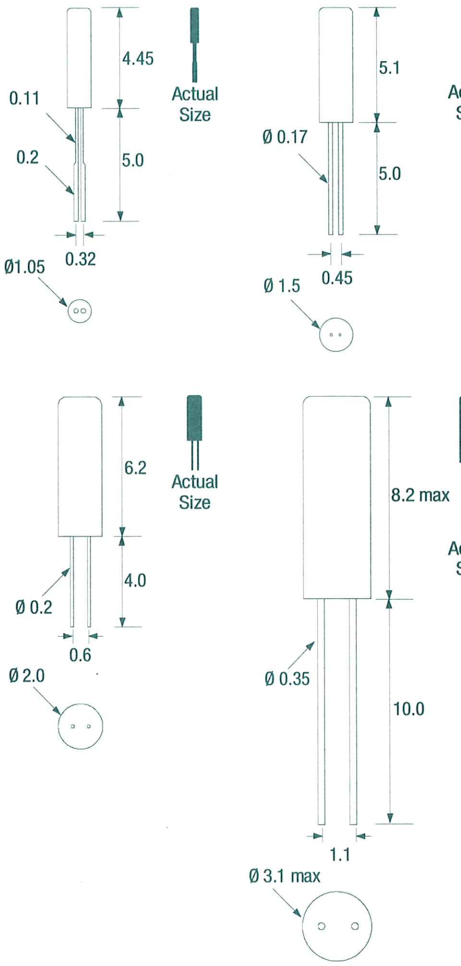
- –55 to 125°C

Frequency Temperature Curve



$$\Delta F/F_o = -0.038\,ppm/°C^2\,(T-T_0)^2 \pm 10\%$$

Outlines (scale 3:1)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR[1] Max	Vibration Mode
32.768kHz	±10ppm to ±100ppm	–20ppm to –100ppm	0 to 50°C	50kΩ max	Fundamental
		–40ppm to –100ppm	0 to 50°C up to –10 to 60°C		
		–70ppm to –100ppm	0 to 50°C up to –20 to 70°C		
		–100ppm	0 to 50°C up to –30 to 80°C		

[1] Crystals in the 1.05 x 4.45mm holder have an ESR of 70kΩ max

QUARTZ-CHECK - WATCH CRYSTAL TIMER

The 32.768kHz crystal oscillator is the most common electronic timing source on earth but cannot normally be adjusted without expensive test equipment and facilities. IQD Quartz-Check is designed specifically for testing 32.768kHz crystals.

This revolutionary instrument allows the user quickly to check and adjust the timing of quartz crystal oscillator circuits.

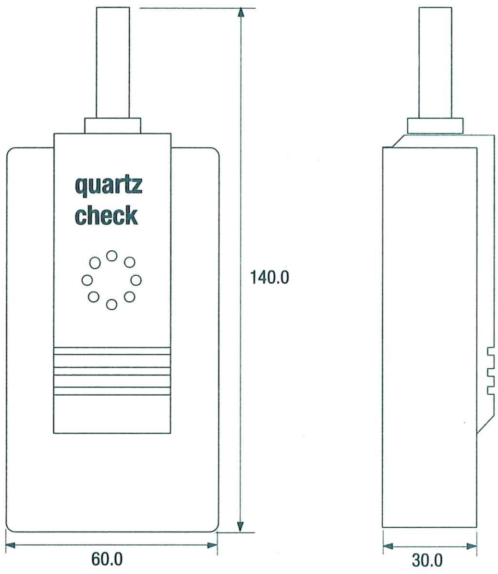
Quartz-Check is inexpensive and works without contact, giving an instantaneous readout. It has an accuracy of 0.3ppm at 25°C and provides an invaluable aid for:

- Production test
- Quality control
- Computer maintenance
- Mobile servicing
- Service and repair shops

To operate Quartz-check, hold its probe close to the crystal. Press the button and the unique rotating LED display gives an instant readout of fast or slow. The rate of rotation indicates the timing error. Quartz-Check offers the following features:

- Inexpensive
- Pocket-portable
- One hand operation
- Non-contact operation
- Accurate, sensitive and unambiguous
- Unique rotating LED display
- Display of rotation indicates fast or slow

Outline (scale 1:2)



General Specifications

- Aging: ±3ppm max first year

Standard Operating Temperature Ranges

- 15 to 35°C

Standard Storage Temperature Range

- 0 to 60°C

Electrical Specification - Maximum Limiting Values

Frequency	Display	Accuracy @ 25°C	Battery	Humidity	Weight
32.768kHz	8 LED ring	0.3ppm	9V PP3 Alkaline (battery low indicator)	30 to 85% non-condensing	150gms

CYLINDER CRYSTALS (2 x 6) 10.0 to 200.0kHz

ISSUE 3; 21 MARCH 1994

Holder Style

- 2 x 6.2mm Cylinder crystals are press sealed

General Specifications

- Load Capacitance (C_L): 3pf to 15pf
- Drive Level: 1.0μW max

Standard Frequency Tolerances and Stabilities

- ±30ppm, ±50ppm, ±100ppm, ±150ppm, ±200ppm, ±300ppm

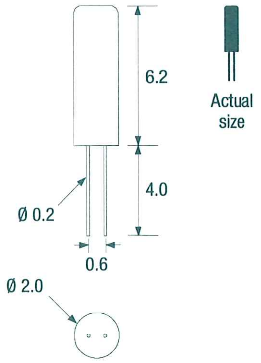
Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C

Standard Storage Temperature Range

- –55 to 125°C

Outline (scale 3:1)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 99.999kHz	±30ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	35kΩ to 15kΩ	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		
100.0 to 200.0kHz	±30ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	12kΩ to 8kΩ	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		

CYLINDER CRYSTALS (3 x 8) 15.0kHz to 60.0MHz

ISSUE 3; 2 SEPTEMBER 1993

Holder Style

- 3 x 8.8mm cylinder crystals are press sealed

General Specifications

- Load Capacitance (C_L):
  3pf to 15pf (15kHz to 2.7MHz)
  10pf to 50pf or Series (3.57MHz to 60MHz)
- Drive Level:
  1µW max (15kHz to 1.536MHz)
  5µW max (1.7MHz to 2.699MHz)
  10µW typ, 100µW max (3.57MHz to 60.0MHz)

Standard Frequency Tolerances and Stabilities

- ±10ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm, ±150ppm, ±200ppm, ±300ppm

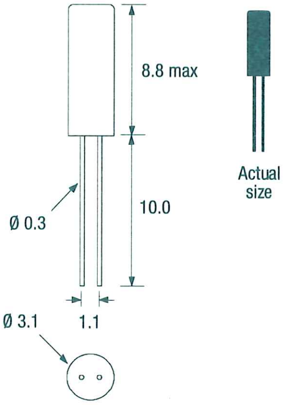
Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C

Standard Storage Temperature Range

- –65 to 150°C

Outline (scale 2:1)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
15kHz to 150kHz	±20ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	35kΩ to15kΩ	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		
350kHz to 1.536MHz	±50ppm to ±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	1.5kΩ max	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
		±300ppm	0 to 50°C up to –55 to 105°C		
1.7 to 2.699MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –55 to 105°C	80Ω typ	Fundamental
3.57 to 3.699MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	200Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
3.70 to 3.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	180Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
4.0 to 5.2MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	150Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
5.0 to 9.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	120Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
10.0 to 15.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	50Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
16.0 to 25.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	40Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
26.0 to 35.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	100Ω	3rd Overtone
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
36.0 to 60.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	80Ω	3rd Overtone
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±100ppm	0 to 50°C up to –55 to 105°C		

CX1 CRYSTALS 10.0kHz to 2.0MHz

ISSUE 1; 8 JULY 1992

Description

CX1 crystals are high quality chemically etched resonators manufactured with a photolithographic process

The CX1H version is a tuning fork resonator intended for use in simple series oscillators over the frequency range 10.0 to 560.0kHz

The CX1V versions are intended for use in simple Pierce oscillators. They are tuning fork resonators over the frequency range 10 to 560kHz and length extensional resonators over the range 561kHz to 2MHz

Holder Style

- CX1 crystals are housed in a ceramic package, hermetically sealed, with a soft soldered glass lid & leads.

General Specifications

- Load Capacitance (C_L):
  9pf (10.0 to 100.999kHz)
  4pf (101.0 to 560.999kHz)
  10pf (561.0kHz to 2.0MHz)
  Other values available upon request
- Shunt Capacitance (C_O): 1.0 to 3.0pf
- Drive Level:
  0.5μW max (10.0 to 20.999kHz)
  1.0μW max (21.0kHz to 2.0MHz)
- Aging: ±3ppm max first year

Standard Frequency Tolerances and Stabilities

- ±30ppm, ±50ppm, ±100ppm, ±500ppm, ±10,000ppm

Standard Operating Temperature Ranges

- –40 to 80°C
- –55 to 125°C

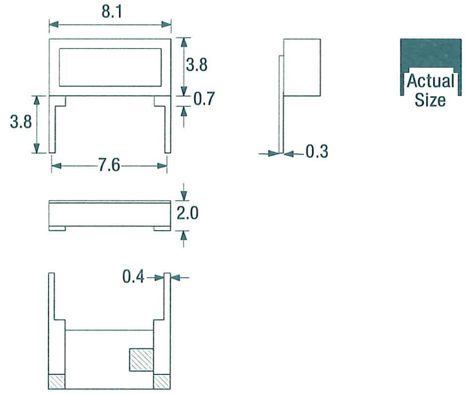
Standard Storage Temperature Range

- –55 to 125°C

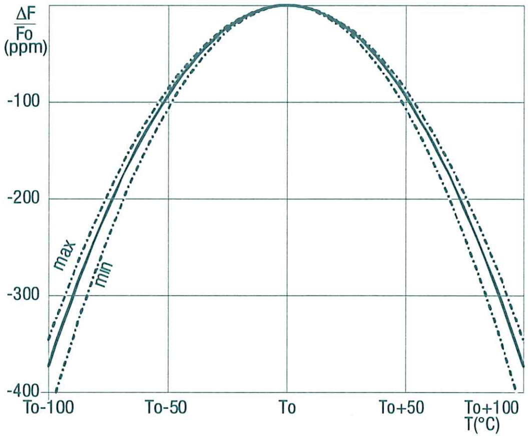
Environmental Specification

- Shock: 5000g, 0.3mS ½ sine
- Vibration: 20g, 10 to 2000Hz

Outline (scale 2:1)



Frequency Temperature Curve



$\Delta F/F_o = -0.038\,ppm/°C^2\,(T-T_0)^2 \pm 10\%$

Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 20.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	200kΩ to 150kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
21.0 to 49.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	150kΩ to 80kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
50.0 to 74.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	80kΩ to 50kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
75.0 to 99.999kHz	±50 to ±10000ppm	–90ppm	–10 to 70°C	50kΩ to 40kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
100.0 to 200.999kHz	±50 to ±10000ppm	–90ppm	–10 to 70°C	40kΩ to 20kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
201.0 to 299.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	9kΩ	3rd Overtone
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
300.0 to 560.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	9kΩ to 20kΩ	3rd Overtone
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
561.0 to 999.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
1.0 to 1.599MHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
1.6 to 2.0MHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		

CX1 CRYSTALS 8.0 to 32.0MHz

ISSUE 2; 10 SEPTEMBER 1993

Description

CX1 crystals are high quality chemically etched resonators manufactured with a photolithographic process

Holder Style

- CX1 crystals are housed in a ceramic package, hermetically sealed, with a soft soldered glass lid & leads.

General Specifications

- Load Capacitance (C_L): 20pF
  Other values available upon request
- Shunt Capacitance (C_O): 2.0 to 5.0pf
- Drive Level: 500µW max
- Aging: ±3ppm max first year

Standard Frequency Tolerances and Stabilities

- ±50ppm, ±100ppm, ±250ppm, ±10,000ppm

Standard Operating Temperature Ranges

- –40 to 80°C
- –55 to 125°C

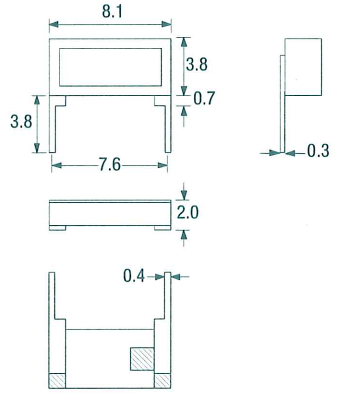
Standard Storage Temperature Range

- –55 to 125°C

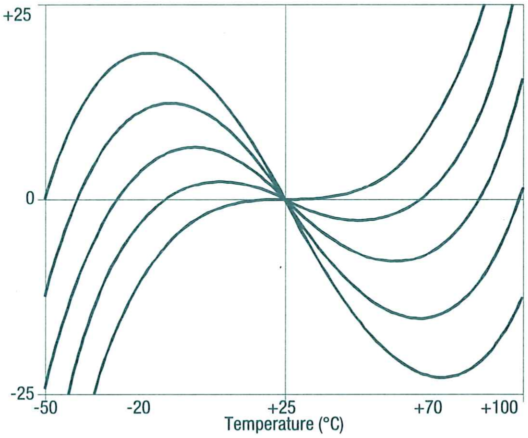
Environmental Specification

- Shock: 5000g, 0.3mS ½ sine
- Vibration: 20g, 10 to 2000Hz

Outline (scale 2:1)



Frequency Temperature Curve



Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
8.0 to 9.999MHz	±50 to ±1000ppm	±30ppm	−10 to 70°C	100Ω	Fundamental AT cut
		±50ppm	−40 to 85°C		
		±100ppm	−55 to 125°C		
10.0 to 12.999MHz	±50 to ±1000ppm	±30ppm	−10 to 70°C	75Ω	Fundamental AT cut
		±50ppm	−40 to 85°C		
		±100ppm	−55 to 125°C		
13.0 to 25.999MHz	±50 to ±1000ppm	±30ppm	−10 to 70°C	50Ω	Fundamental AT cut
		±50ppm	−40 to 85°C		
		±100ppm	−55 to 125°C		
26.0 to 32.0MHz	±50 to ±1000ppm	±30ppm	−10 to 70°C	75Ω	Fundamental AT cut
		±50ppm	−40 to 85°C		
		±100ppm	−55 to 125°C		

Please note that higher frequencies are available upon request; please contact our sales office.

HC35 (TO5) CRYSTALS 8.0 to 210.0MHz

ISSUE 4; 21 MARCH 1994

Holder Style

- HC35 (TO5) crystals are cold welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C
  –55 to 125°C

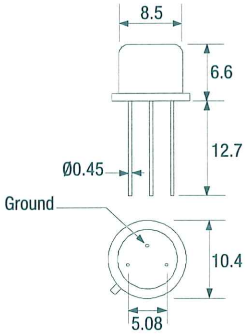
Standard Storage Temperature Range

- –55 to 125°C

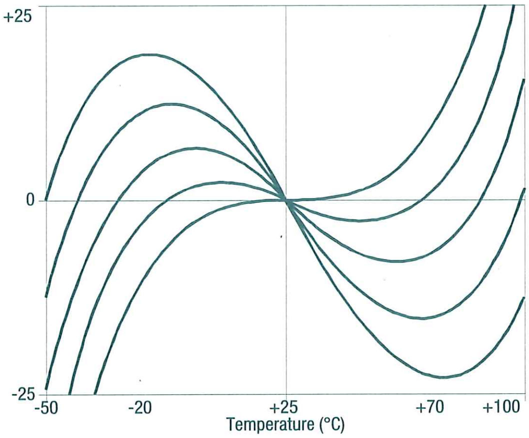
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
8.0 to 14.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	25Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
15.0 to 30.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	20Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
25.0 to 90.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	40Ω	3rd Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
60.0 to 150.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	60Ω	5th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
125.0 to 175.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	100Ω	7th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
170.0 to 210.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	200Ω	9th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

UM1 (HC45) CRYSTALS 950.0kHz to 250.0MHz

ISSUE 4; 21 MARCH 1994

Holder Style

- UM1 crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires
- Holders suffixed '-3L'have a centre third wire which grounds the case

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C
  –55 to 125°C

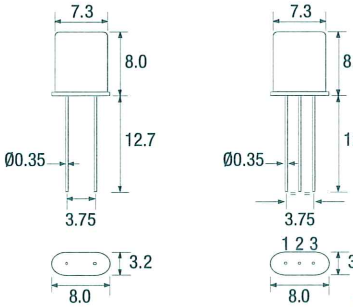
Standard Storage Temperature Range

- –55 to 125°C

Environmental Specification

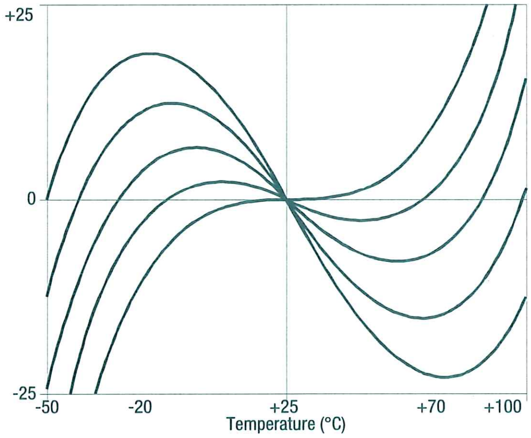
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outlines



Pin connections
1. Crystal
2. Case & Ground
3. Crystal

Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
950.0kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	3000Ω	Fundamental AT cut
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
6.0 to 9.99MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	80Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
10.0 to 14.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	60Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
15.0 to 30.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	30Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
25.0 to 90.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	45Ω	3rd Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
60.0 to 150.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	100Ω	5th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
125.0 to 175.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	150Ω	7th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
175.0 to 250.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	150Ω	9th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

UM5 CRYSTALS 10.0 to 175.0MHz

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Holder Style

- UM5 crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires
- Holders suffixed '-3L'have a centre third wire which grounds the case

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C

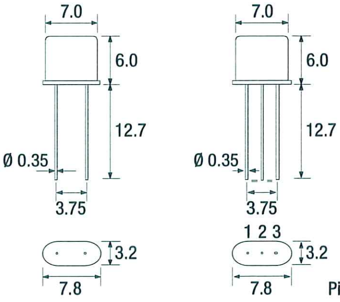
Standard Storage Temperature Range

- –55 to 125°C

Environmental Specification

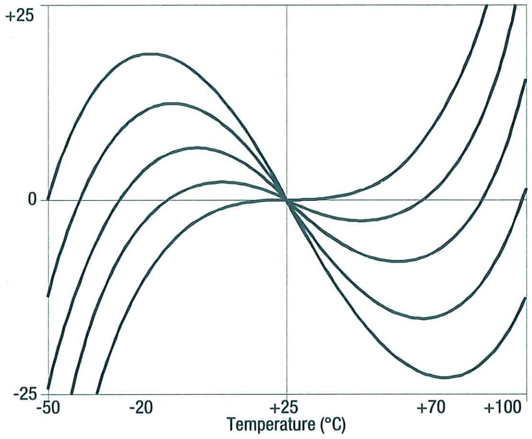
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outlines



Pin connections
1. Crystal
2. Case & ground
3. Crystal

Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 15.999MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –10 to 60°C	60Ω	Fundamental AT cut
16.0 to 19.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	50Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
20.0 to 29.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	40Ω	Fundamental AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
30.0 to 40.0MHz	±10ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	40Ω	Fundamental AT cut
40.0 to 90.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	120Ω	3rd Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
70.0 to 150.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	150Ω	5th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
125.0 to 175.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –30 to 80°C	150Ω	7th Overtone AT cut
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		

HC49/4H CRYSTALS 3 to 60MHz

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Holder Style

- HC49/4H crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires
- Holders suffixed '-3L'have a centre third wire which grounds the case

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 10μW typical, 100μW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±10ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C

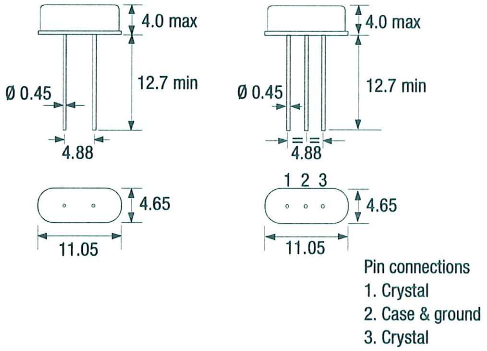
Standard Storage Temperature Range

- –55 to 125°C

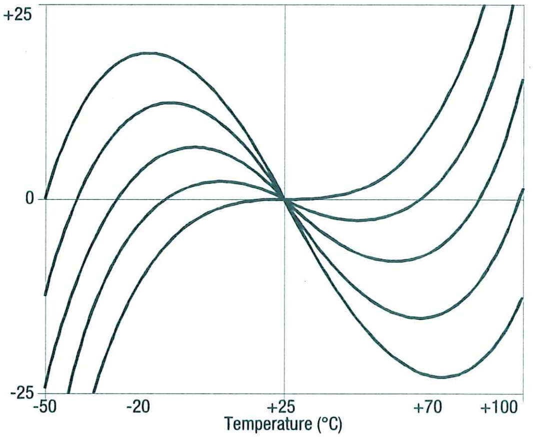
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

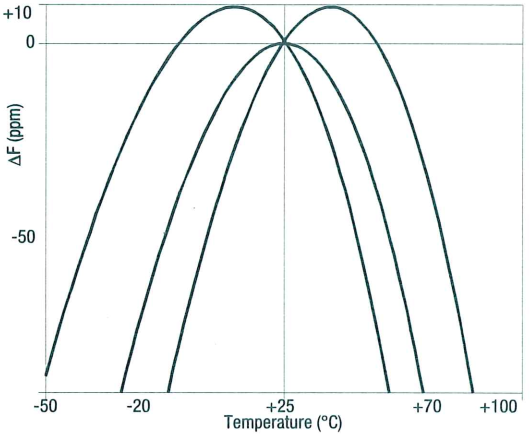
Outline



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Typical Frequency vs Temperature Curves for various angles of BT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
3.0 to 4.999MHz	±20ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	200Ω	Fundamental AT cut
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
5.0 to 7.999MHz	±20ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	120Ω	Fundamental AT cut
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
8.0 to 11.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	70Ω	Fundamental AT cut
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
12.0 to 25.0MHz	±20ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	50Ω	Fundamental AT cut
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
25.0 to 40.0MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C	50Ω	Fundamental BT cut
		±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±80ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
25.0 to 60.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	100Ω	3rd Overtone AT cut
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±100ppm	0 to 50°C up to –55 to 105°C		

HC49 (HC43) CRYSTALS 400kHz to 322MHz

ISSUE 5; 21 MARCH 1994

Holder Style

- HC49 crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires; HC49/T is truncated version; HC50 is plug-in version
- HC43 crystals are cold welded; HC43/T is truncated version; HC42 is plug-in version
- Holders suffixed '-3L'have a centre third wire which grounds the case; this is not applicable to the HC50 and HC42
- Truncated versions are only available in the frequency range 4.0 to 322.0MHz

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±2.5ppm, ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C
  –55 to 125°C

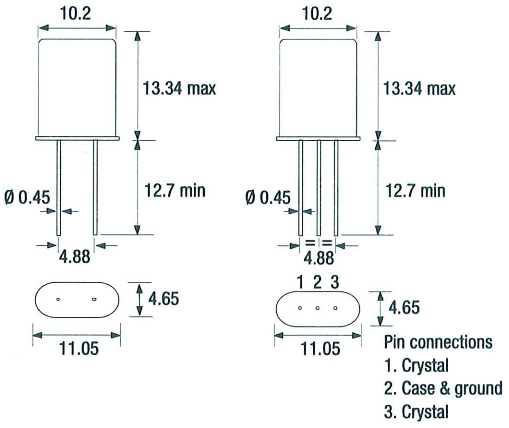
Standard Storage Temperature Range

- –55 to 125°C

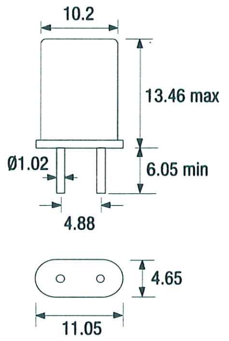
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

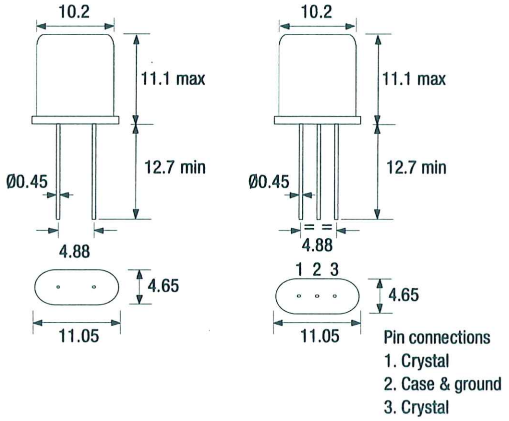
Outline - HC49 & HC43



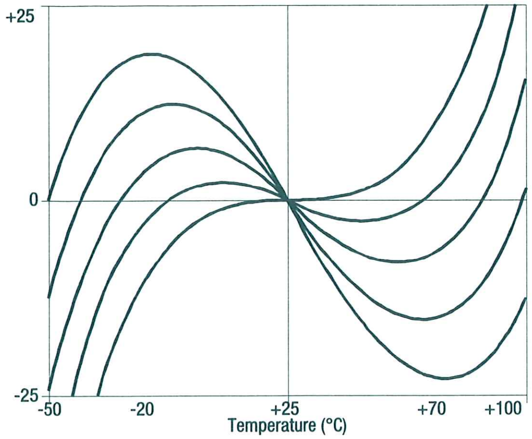
Outline - HC50 & HC42



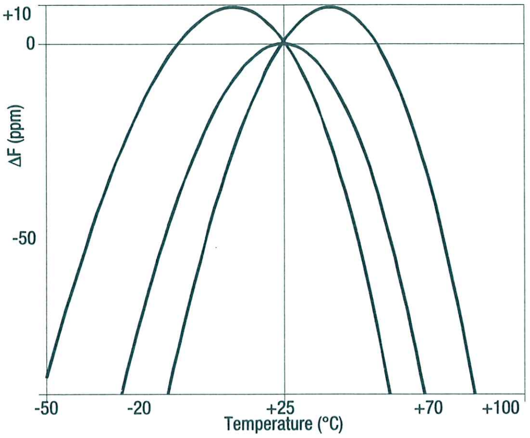
Outline - HC49/T & HC43/T



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Typical Frequency vs Temperature Curves for various angles of BT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
400kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	2000Ω	Fundamental CT cut SL cut
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
1.6 to 2.999MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	600Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
3.0 to 3.999MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	150Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
4.0 to 6.999MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	100Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
7.0 to 9.999MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	50Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 30.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	35Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
18.0 to 46.0MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C	35Ω	Fundamental BT cut
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
21.0 to 90.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	40Ω	3rd Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
55.0 to 138MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C	40Ω	3rd Overtone BT cut
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
60.0 to 150.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	70Ω	5th Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
90.0 to 225MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C	70Ω	5th Overtone BT cut
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
85.0 to 210.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	100Ω	7th Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
125.0 to 322MHz	±2.5ppm to ±100ppm	±30ppm to ±100ppm	0 to 50°C up to –10 to 60°C	100Ω	7th Overtone BT cut
		±50ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±100ppm	0 to 50°C up to –30 to 80°C		
110.0 to 270.0MHz	±2.5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	100Ω	9th Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

HC51 & HC47 CRYSTALS 160kHz to 50MHz

ISSUE 4; 21 MARCH 1994

Holder Style

- HC51 crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires; HC48 is plug-in version
- HC47 crystals are cold welded; HC36 is plug-in version
- Holders suffixed '-3L'have a centre third wire which grounds the case; this is not applicable to the HC36 and HC48

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±5ppm, ±10ppm, ±15ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C
  –55 to 105°C
  –55 to 125°C

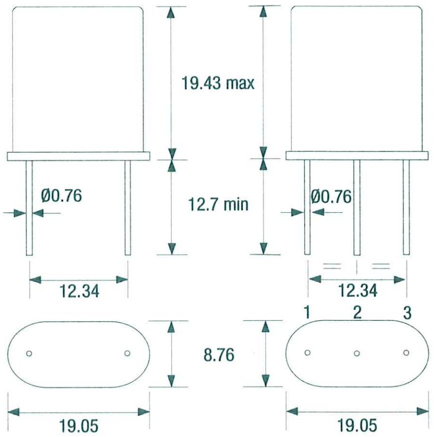
Standard Storage Temperature Range

- –55 to 125°C

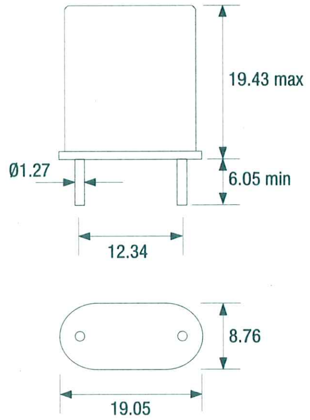
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 500Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

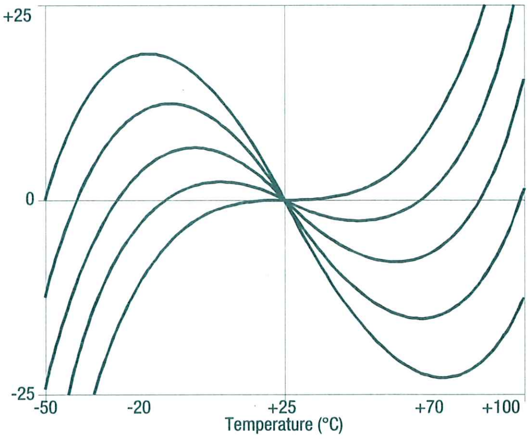
Outline - HC51 & HC47



Outline - HC48 & HC36



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
160kHz to 1.3MHz	±20ppm to ±100ppm	±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C	2000Ω	Fundamental CT cut DT cut SL cut
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±100ppm	0 to 50°C up to –55 to 105°C		
890kHz to 1.499MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	700Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
1.5 to 2.499MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	350Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
2.5 to 3.499MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	200Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
3.5 to 6.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	100Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
7.0 to 11.999MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	40Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
12.0 to 24.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	20Ω	Fundamental AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
9.0 to 30.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	20Ω	3th Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		
15.0 to 50.0MHz	±5ppm to ±100ppm	±5ppm to ±100ppm	0 to 50°C up to –20 to 70°C	20Ω	5th Overtone AT cut
		±7.5ppm to ±100ppm	0 to 50°C up to –30 to 80°C		
		±10ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
		±20ppm to ±100ppm	0 to 50°C up to –55 to 105°C		
		±25ppm to ±100ppm	0 to 50°C up to –55 to 125°C		

OVEN CRYSTALS - Section Contents

HC49 (HC43) Oven Crystals 4.0MHz to 150MHz . . 50

HC49 (HC43) OVEN CRYSTALS 4.0MHz to 150MHz

ISSUE 3; 21 MARCH 1994

Holder Style

- HC49 crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires; HC49/T is truncated version; HC50 is plug-in version
- Holders suffixed '-3L'have a centre third wire which grounds the case

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 1mW max
- Shunt Capacitance (C_0): 9pf max
- Aging: All crystals pre-aged for 48hrs at the requested temperature of operation

Standard Frequency Tolerances

- ±2.5ppm, ±5ppm, ±10ppm

Standard Frequency Stabilities

- ±0.25ppm, ±0.5ppm, ±1ppm, ±2ppm

Standard Operating Temperatures

- 60°C, 65°C, 70°C, 75°C, 80°C, 85°C, 90°C

Standard Operating Temperature Ranges

- 55 to 65°C
  60 to 70°C
  65 to 75°C
  70 to 80°C
  75 to 85°C
  80 to 90°C
  85 to 95°C

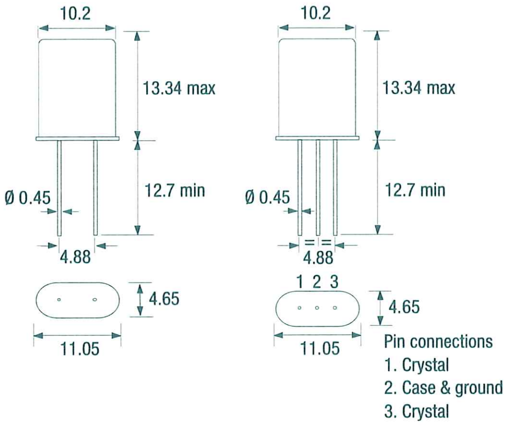
Standard Storage Temperature Range

- –55 to 125°C

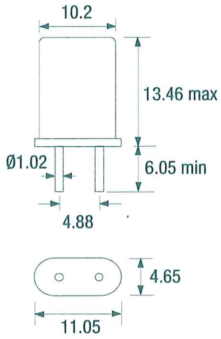
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

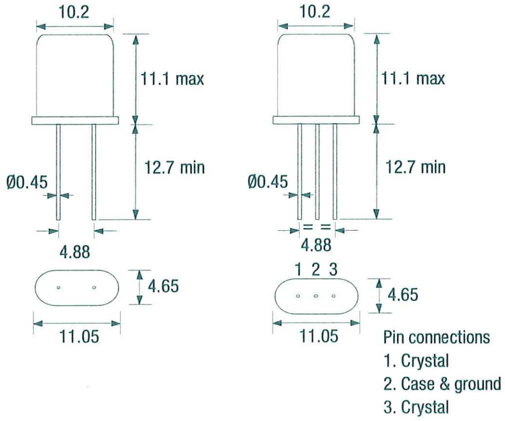
Outline - HC49 & HC49-3L



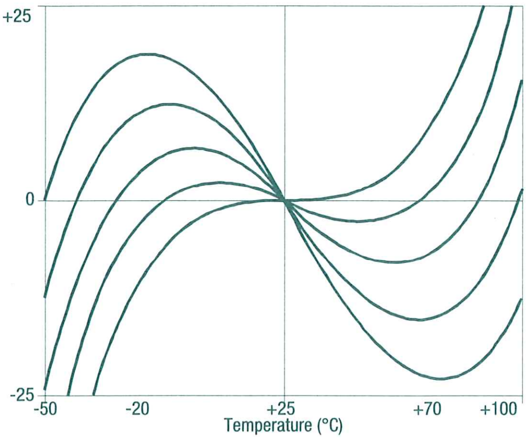
Outline - HC50



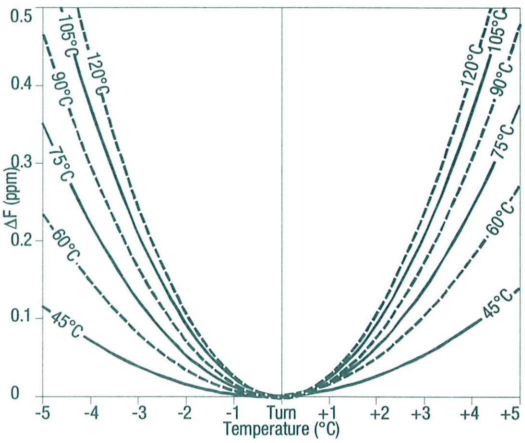
Outline - HC49/T & HC49/T-3L



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Upper Turning Point Curves



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
4.0 to 6.999MHz	±2.5ppm to ±10ppm	±0.25ppm to ±2ppm	55 to 65°C up to 85 to 95°C	100Ω	Fundamental AT cut
7.0 to 9.999MHz	±2.5ppm to ±10ppm	±0.25ppm to ±2ppm	55 to 65°C up to 85 to 95°C	50Ω	Fundamental AT cut
10.0 to 30.0MHz	±2.5ppm to ±10ppm	±0.25ppm to ±2ppm	55 to 65°C up to 85 to 95°C	35Ω	Fundamental AT cut
21.0 to 90.0MHz	±2.5ppm to ±10ppm	±0.25ppm to ±2ppm	55 to 65°C up to 85 to 95°C	40Ω	3rd Overtone AT cut
60.0 to 150.0MHz	±2.5ppm to ±10ppm	±0.25ppm to ±2ppm	55 to 65°C up to 85 to 95°C	70Ω	5th Overtone AT cut

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IQXO-904, -905, -906, -907 152
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SPECIFYING CRYSTAL OSCILLATORS

Commercial Temperature Range

A typical crystal oscillator specification reads like this:

19.66080MHz IQXO-100 B

Frequency
Model Number
Frequency Stability

Industrial & Military Temperature Range

A typical crystal oscillator specification reads like this:

19.66080MHz IQXO-100 JM 50ppm

Frequency
Model Number
Operating Temperature Range
Frequency Stability

The following notes to each element of the specification in turn show how to arrive at a specification that will fully describe the oscillator you require.

Frequency

Frequency is normally specified in Kilohertz (kHz) up to 9999.999 kHz and in Megahertz (MHz) from 10.0MHz upwards except for integer values which are all specified in MHz. All our computer-generated transaction documents follow this standard convention automatically.

Most oscillators are capable of adjustment to within less than 10 parts per million of nominal frequency during manufacture, so the frequency should be described to seven significant figures. If seven significant figures are not used, we assume that any figure that might follow those given may be taken as zero. Thus a frequency given as 16.6MHz will be taken as 16.60, not 16.66667 as would be intended, and should be specified, if what you want is 50 divided by 3.

Some specifiers extend the use of kHz to all oscillators operating in fundamental mode, reserving MHz for overtones. To minimise the possibility of misunderstanding it is best to use the normal method and specify fundamental or overtone mode separately if this is important to the application.

Model Number

The model number incorporates information which describes substrate design and holder style.

Frequency Stability

The frequency stability of an oscillator is specified as an absolute value which allows for variation of the supply voltage and for the frequency tolerance at 25°C. This value is specified as 'parts per million' (ppm) and is available in three ranges, ±25ppm, ±50ppm and ±100ppm.

For commercial temperature range oscillators the following codes apply:

- A - ±25ppm
- B - ±50ppm
- C - ±100ppm

For industrial and military temperature range oscillators the normal tolerance is ±100ppm and is not marked on the oscillator holder. If ±25ppm or ±50ppm is specified the value selected is engraved on the oscillator holder.

Operating Temperature Range

An oscillator is designed to work over any one of three temperature ranges:

- Commercial: 0 to 70°C
- Industrial: –40 to 90°C
- Military: –55 to 125°C

For industrial and military temperature range oscillators the following codes apply:

- JI - Industrial temperature range
- JM - Military temperature range

Although in general oscillators will continue to operate outside their normal temperature range with a degredation in frequency stability, damage can result if the temperatures reached are excessive.

Outline Drawings

Dimensions on the crystal outline drawings are shown only as a guide. Precise dimensions of crystal holders are available from our factory upon request. All dimensions are shown in mm. All outlines are at a scale of 1:1 unless otherwise specified.

Standard Frequency Stabilities

- ±5ppm, ±10ppm, ±15ppm, ±25ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  0 to 70°C
  –40 to 90°C
  –55 to 125°C

Non-Standard Testing

- Military oscillators to MIL standard 55310
- Burn-in for 168 hours at 125°C

For full details see page 56.

Delivery Options

The following delivery options are available; timescales refer to despatch from our UK factory. Prices for larger quantities and longer delivery times are lower due to substantially reduced manufacturing costs.

- 3 working days (Express service)
- 5 working days (Express service)
- 7 working days (Express service)
- 10 working days (Express service)
- 3 to 4 weeks (Standard service)
- 6 weeks (Low cost service)
- 10 to 12 weeks (Low cost service)

Minimum Order Information Required

- Frequency + Holder + Frequency Stability

Additional Order Information Where Applicable

- Operating Temperature Range + Model Number

Stability Conversion Chart

10^X	PPM	%
10^{-3}	1000	0.1
10^{-4}	100	0.01
10^{-5}	10	0.001
10^{-6}	1	0.0001
10^{-7}	0.1	0.00001
10^{-8}	0.01	0.000001
10^{-9}	0.001	0.0000001
10^{-10}	0.0001	0.00000001

OSCILLATOR ENVIRONMENTAL TESTING SERVICES

BURN-IN

The burn-in test is performed for the purpose of screening or eliminating marginal devices, those with inherent defects or defects resulting from manufacturing aberrations which cause time- and stress- dependent failures. In the absence of burn-in these defective devices would be expected to result in infant mortality or early lifetime failures under use conditions.

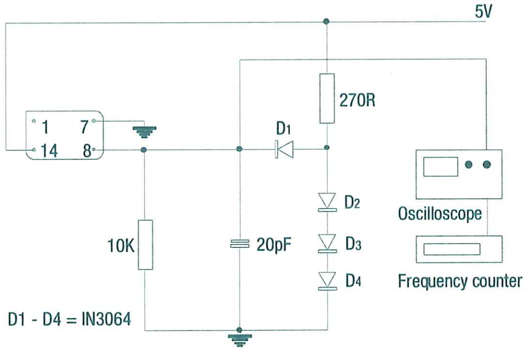
Tests are performed in general accordance with MIL-STD 883, method 1015.8.

Burn-in test = 168 hours at the appropriate upper temperature, at maximum electrical load (see test circuit opposite).

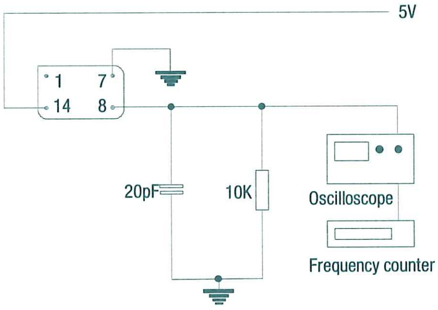
At completion of the test, the frequency of the oscillator is remeasured at both extremes of the operating temperature range to establish that the frequency remains within the specification. The following parameters of the oscillator are then measured at 23°C:

- Frequency Tolerance (e.g. ±100ppm)
- Rise (t_r) and fall (t_f) times
- Voltage states V_{High} and V_{Low}
- Load current

TTL Test Circuit



CMOS Test Circuit



STOCK OSCILLATORS

8-pin DIL Clock Oscillators

Frequency	Type	Frequency Stability	Model No.	Stock No.
1843.20kHz	CMOS	±100ppm	IQXO-22C	X361H
3686.40kHz	HCMOS	±100ppm	IQXO-22C	X363H
4.0MHz	HCMOS	±100ppm	IQXO-22C	X351H
8.0MHz	HCMOS	±100ppm	IQXO-22C	X352H
8.0MHz	TTL	±50ppm	IQXO-3	U301A
8388.608kHz	TTL	±50ppm	IQXO-3	U305A
9600.0kHz	TTL	±50ppm	IQXO-3	U307A
9830.4kHz	TTL	±50ppm	IQXO-3	U309A
10.0MHz	HCMOS	±100ppm	IQXO-22C	X353H
10.0MHz	TTL	±50ppm	IQXO-3	U311A
12.0MHz	HCMOS	±100ppm	IQXO-22C	X354H
12.0MHz	TTL	±50ppm	IQXO-3	U313A
12.288MHz	TTL	±50ppm	IQXO-3	U315A
14.31818MHz	HCMOS	±100ppm	IQXO-22C	X373H
15.0MHz	TTL	±50ppm	IQXO-3	U321A
16.0MHz	HCMOS	±100ppm	IQXO-22C	X355H
16.0MHz	TTL	±50ppm	IQXO-3	U323A
16.3840MHz	TTL	±50ppm	IQXO-3	U325A
16.77722MHz	TTL	±50ppm	IQXO-3	U327A
19.2MHz	TTL	±50ppm	IQXO-3	U329A
19.66080MHz	TTL	±50ppm	IQXO-3	U331A
20.0MHz	HCMOS	±100ppm	IQXO-22C	X356H
20.0MHz	TTL	±50ppm	IQXO-3	U333A
24.0MHz	HCMOS	±100ppm	IQXO-22C	X371H
24.0MHz	TTL	±50ppm	IQXO-3	U334A
25.0MHz	TTL	±50ppm	IQXO-3	U336A
25.1750MHz	HCMOS	±100ppm	IQXO-22C	X374H
28.3220MHz	HCMOS	±100ppm	IQXO-22C	X375H
28.63636MHz	HCMOS	±100ppm	IQXO-22C	X376H
32.0MHz	HCMOS	±100ppm	IQXO-22C	X360H
33.86880MHz	HCMOS	±100ppm	IQXO-22C	X377H
40.0MHz	HCMOS	±100ppm	IQXO-22C	X357H
50.0MHz	HCMOS	±100ppm	IQXO-22C	X358H
60.0MHz	HCMOS	±100ppm	IQXO-22C	X381H
64.0MHz	HCMOS	±100ppm	IQXO-22C	X384H

14-pin DIL Clock Oscillators

Frequency	Type	Frequency Stability	Model No.	Stock No.
1.0MHz	TTL	±100ppm	IQXO-200C	X201A
1.0MHz	TTL	±100ppm	IQXO-200M	X201B
1843.20kHz	TTL	±100ppm	IQXO-200C	X207A
2.0MHz	TTL	±100ppm	IQXO-200C	X202A
2457.60kHz	TTL	±100ppm	IQXO-200C	X206A
3.0MHz	TTL	±100ppm	IQXO-200C	X203A
3686.40kHz	TTL	±100ppm	IQXO-100C	X115A
4.0MHz	TTL	±100ppm	IQXO-100C	X101A
4.0MHz	TTL	±100ppm	IQXO-100M	X101B
4.0MHz	TTL	±100ppm	IQXO-200M	X205B
4.0MHz	HCMOS	±100ppm	IQXO-350C	X351A
4096.0kHz	TTL	±100ppm	IQXO-100C	X123A
4194.304kHz	TTL	±100ppm	IQXO-100C	X119A
4915.20kHz	TTL	±100ppm	IQXO-100C	X102A
5.0MHz	TTL	±100ppm	IQXO-100C	X103A
5068.80kHz	TTL	±100ppm	IQXO-100C	X104A
6.0MHz	TTL	±100ppm	IQXO-100C	X105A
6.0MHz	TTL	±100ppm	IQXO-100M	X105B
6.1440MHz	TTL	±100ppm	IQXO-100C	X106A
8.0MHz	TTL	±100ppm	IQXO-100C	X107A
8.0MHz	TTL	±100ppm	IQXO-100M	X107B
8.0MHz	HCMOS	±100ppm	IQXO-350C	X352A
9600.0kHz	TTL	±100ppm	IQXO-100C	E110A
9830.40kHz	TTL	±100ppm	IQXO-100C	X121A
9830.40kHz	TTL	±100ppm	IQXO-100M	X121B
9830.40kHz	HCMOS	±100ppm	IQXO-350C	X359A
10.0MHz	TTL	±100ppm	IQXO-100C	X108A
10.0MHz	TTL	±100ppm	IQXO-100M	X108B
10.0MHz	HCMOS	±100ppm	IQXO-350C	X353A
10.0 & 20.0MHz	DUAL	±100ppm	IQXO-450C	X451A
12.0MHz	TTL	±100ppm	IQXO-100C	X110A
12.0MHz	TTL	±100ppm	IQXO-100M	X110B
12.0MHz	HCMOS	±100ppm	IQXO-350C	X354A
12.2880MHz	TTL	±100ppm	IQXO-100C	X122A
14.74560MHz	TTL	±100ppm	IQXO-100C	X118A
15.0MHz	TTL	±100ppm	IQXO-100C	X111A
15.0MHz	TTL	±100ppm	IQXO-100M	X111B
16.0MHz	TTL	±100ppm	IQXO-100C	X112A
16.0MHz	TTL	±100ppm	IQXO-100M	X112B
16.0MHz	HCMOS	±100ppm	IQXO-350C	X355A
16.3840MHz	HCMOS	±50ppm	IQXO-350B	X370A
18.4320MHz	TTL	±100ppm	IQXO-100C	X117A
19.66080MHz	TTL	±100ppm	IQXO-100C	X113A
19.66080MHz	HCMOS	±100ppm	IQXO-350C	X364A

Frequency	Type	Frequency Stability	Model No.	Stock No.
20.0MHz	TTL	±100ppm	IQXO-100C	X109A
20.0MHz	TTL	±100ppm	IQXO-100M	X109B
20.0MHz	HCMOS	±100ppm	IQXO-350C	X356A
24.0MHz	TTL	±100ppm	IQXO-100C	X114A
24.0MHz	TTL	±100ppm	IQXO-100M	X114B
24.0MHz	HCMOS	±100ppm	IQXO-350C	X371A
24.5760MHz	TTL	±100ppm	IQXO-100C	X116A
25.0MHz	TTL	±100ppm	IQXO-100C	X120A
25.0MHz	TTL	±100ppm	IQXO-100M	X120B
25.1750MHz	TTL	±100ppm	IQXO-100C	X127A
26.0MHz	TTL	±100ppm	IQXO-100C	E109A
28.3220MHz	TTL	±100ppm	IQXO-100C	X128A
28.6360MHz	TTL	±100ppm	IQXO-100C	X126A
29.49120MHz	TTL	±100ppm	IQXO-100C	X129A
30.0MHz	TTL	±100ppm	IQXO-500C	X505A
32.0MHz	TTL	±100ppm	IQXO-500C	X501A
32.0MHz	HCMOS	±100ppm	IQXO-350C	X360A
32.7680MHz	TTL	±100ppm	IQXO-500C	X508A
33.330MHz	TTL	±100ppm	IQXO-500C	X512A
33.86880MHz	TTL	±100ppm	IQXO-500C	X515A
40.0MHz	TTL	±100ppm	IQXO-500C	X502A
40.0MHz	TTL	±100ppm	IQXO-500M	X502B
40.0MHz	HCMOS	±100ppm	IQXO-350C	X357A
48.0MHz	TTL	±100ppm	IQXO-500C	X503A
50.0MHz	TTL	±100ppm	IQXO-500C	X511A
50.0MHz	TTL	±100ppm	IQXO-500M	X511B
50.0MHz	HCMOS	±100ppm	IQXO-350C	X358A
54.0MHz	TTL	±100ppm	IQXO-500C	E127A
60.0MHz	TTL	±100ppm	IQXO-500C	X504A
64.0MHz	TTL	±100ppm	IQXO-500C	X513A
65.5360MHz	LS-TTL	±100ppm	IQXO-351C	X372A
66.0MHz	HCMOS	±100ppm	IQXO-350C	X368A
72.0MHz	HCMOS	±100ppm	IQXO-133C	X509B
80.0MHz	TTL	±100ppm	IQXO-500C	X510A
80.0MHz	ECL	±100ppm	IQXO-900C	X901A
100.0MHz	ECL	±100ppm	IQXO-910C	X902A
110.0MHz	ECL	±100ppm	IQXO-900C	X904A
120.0MHz	ECL	±100ppm	IQXO-900C	X903A

STANDARD TTL OSCILLATORS - Delivery Options

Standard TTL Oscillators - 3-pin HC49/5H

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 70.MHz	±50ppm to ±100ppm	0 to 70°C	IQXO-33	10 to 12 weeks	Available on request

Standard TTL Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
32.0kHz to 80.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-20	3 days to 12 weeks	68
		−40 to 90°C	IQXO-20JI		70
	±50ppm to ±100ppm	−55 to 125°C	IQXO-20JM		72

Standard TTL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
7.8 to 249.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-200	6 to 12 weeks	Available on request
		−40 to 90°C	IQXO-200JI		
	±50ppm to ±100ppm	−55 to 125°C	IQXO-200JM		
250.0kHz to 3.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-200	3 days to 12 weeks	102
		−40 to 90°C	IQXO-200JI		104
	±50ppm to ±100ppm	−55 to 125°C	IQXO-200JM		106
4.0 to 29.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-100		102
		−40 to 90°C	IQXO-100JI		104
	±50ppm to ±100ppm	−55 to 125°C	IQXO-100JM		106
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-500		102
		−40 to 90°C	IQXO-500JI		104
	±50ppm to ±100ppm	−55 to 125°C	IQXO-500JM		106
70.0 to 100.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-132		108
		−40 to 90°C	IQXO-132JI		110
	±50ppm to ±100ppm	−55 to 125°C	IQXO-132JM		112

LOW POWER TTL OSCILLATORS - Delivery Options

Standard Low Power TTL Oscillators - 3-pin HC49/5H

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 70.0MHz	±50ppm to ±100ppm	0 to 70°C	IQXO-31	10 to 12 weeks	Available on request

Standard Low Power TTL Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
7.8 to 139.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-21	6 to 12 weeks	Available on request
140kHz to 80MHz				3 days to 12 weeks	74
		–40 to 90°C	IQXO-21JI		76
	±50ppm to ±100ppm	–55 to 125°C	IQXO-21JM		78

Standard Low Power TTL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
7.8 to 249.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-351	6 to 12 weeks	Available on request
250kHz to 70.0MHz		0 to 70°C		3 days to 12 weeks	144
		–40 to 90°C	IQXO-351JI		146
	±50ppm to ±100ppm	–55 to 125°C	IQXO-351JM		148

Precision Low Power TTL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
4.0 to 59.999MHz	±5ppm	0 to 50°C	IQXO-134	10 days to 12 weeks	120
	±10ppm to ±15ppm	0 to 70°C			
60.0 to 70.0MHz					

Independent Dual Output Low Power TTL Oscillators - 14-pin DIL

Any Two Frequencies in the Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
500kHz to 36.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-451	6 to 12 weeks	Available on request
1.8 to 48.0MHz	±100ppm				

Tri-State Low Power TTL Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
250.0kHz to 80.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-24	3 days to 12 weeks	92
		–40 to 90°C	IQXO-24JI		94
	±50ppm to ±100ppm	–55 to 125°C	IQXO-24JM		96

Tri-State Low Power TTL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
250.0 to 999.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-139	3 days to 12 weeks	124
		–40 to 90°C	IQXO-139JI		126
	±50ppm to ±100ppm	–55 to 125°C	IQXO-139JM		128
1.0 to 3.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-140		124
		–40 to 90°C	IQXO-140JI		126
	±50ppm to ±100ppm	–55 to 125°C	IQXO-140JM		128
4.0 to 29.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-141		124
		–40 to 90°C	IQXO-141JI		126
	±50ppm to ±100ppm	–55 to 125°C	IQXO-141JM		128
30.0 to 62.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-142		124
		–40 to 90°C	IQXO-142JI		126
	±50ppm to ±100ppm	–55 to 125°C	IQXO-142JM		128
63.0 to 80.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-143		124
		–40 to 90°C	IQXO-143JI		126
	±50ppm to ±100ppm	–55 to 125°C	IQXO-143JM		128

HCMOS OSCILLATORS - Delivery Options

Standard HCMOS Oscillators - 3-pin HC49/5H

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 70.0MHz	±50ppm to ±100ppm	0 to 70°C	IQXO-32	10 to 12 weeks	100

Standard HCMOS Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
7.8 to 139.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-22	6 to 12 weeks	Available on request
140kHz to 80MHz				3 days to 12 weeks	80
		−40 to 90°C	IQXO-22JI		82
	±50ppm to ±100ppm	−55 to 125°C	IQXO-22JM		84

3.0V HCMOS Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
4.0 to 70.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-25	3 days to 12 weeks	98

Standard HCMOS Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
7.8 to 249.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-350	6 to 12 weeks	Available on request
250kHz to 70.0MHz		0 to 70°C		3 days to 12 weeks	138
		−40 to 90°C	IQXO-350JI		140
	±50ppm to ±100ppm	−55 to 125°C	IQXO-350JM		142
70.0 to 100.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-133		114
		−40 to 90°C	IQXO-133JI		116
	±50ppm to ±100ppm	−55 to 125°C	IQXO-133JM		118

3.0V HCMOS Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
4.0 to 70.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-163	3 days to 12 weeks	136

Precision HCMOS Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
4.0 to 59.999MHz	±5ppm	0 to 50°C	IQXO-135	10 days to 12 weeks	122
	±10ppm to ±15ppm	0 to 70°C			
60.0 to 70.0MHz	±10ppm to ±15ppm	0 to 70°C			

Independent Dual Output HCMOS Oscillators - 14-pin DIL

Any Two Frequencies in the Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
500kHz to 36.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-450	6 to 12 weeks	Available on request
1.8 to 48.0MHz	±100ppm				

Tri-State HCMOS Oscillators - 8-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
250.0kHz to 80.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-23	3 days to 12 weeks	86
		−40 to 90°C	IQXO-23JI		88
	±50ppm to ±100ppm	−55 to 125°C	IQXO-23JM		90

Tri-State HCMOS Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
250.0 to 999.999kHz	±25ppm to ±100ppm	0 to 70°C	IQXO-149	3 days to 12 weeks	130
		−40 to 90°C	IQXO-149JI		132
	±50ppm to ±100ppm	−55 to 125°C	IQXO-149JM		134
1.0 to 3.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-150		130
		−40 to 90°C	IQXO-150JI		132
	±50ppm to ±100ppm	−55 to 125°C	IQXO-150JM		134
4.0 to 29.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-151		130
		−40 to 90°C	IQXO-151JI		132
	±50ppm to ±100ppm	−55 to 125°C	IQXO-151JM		134
30.0 to 62.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-152		130
		−40 to 90°C	IQXO-152JI		132
	±50ppm to ±100ppm	−55 to 125°C	IQXO-152JM		134
63.0 to 80.0MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-153		130
		−40 to 90°C	IQXO-153JI		132
	±50ppm to ±100ppm	−55 to 125°C	IQXO-153JM		134

ECL OSCILLATORS - Delivery Options

Positive Supply ECL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-904	3 days to 12 weeks	152
70.0 to 124.999MHz			IQXO-905		
125.0 to 199.999MHz			IQXO-906	6 to 12 weeks	
200.0 to 325.0MHz			IQXO-907		

Tri-State Positive Supply ECL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-914	6 to 12 weeks	Available on request
70.0 to 124.999MHz			IQXO-915		
125.0 to 200.0MHz			IQXO-916		

Complementary Output Positive Supply ECL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-919	3 days to 12 weeks	156
70.0 to 124.999MHz			IQXO-920		
125.0 to 199.999MHz			IQXO-921	6 to 12 weeks	
200.0 to 325.0MHz			IQXO-922		

Negative Supply ECL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-899	3 days to 12 weeks	150
70.0 to 124.999MHz			IQXO-900		
125.0 to 199.999MHz			IQXO-901	6 to 12 weeks	
200.0 to 325.0MHz			IQXO-902		

Complementary Output Negative Supply ECL Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
30.0 to 69.999MHz	±25ppm to ±100ppm	0 to 70°C	IQXO-909	3 days to 12 weeks	154
70.0 to 124.999MHz			IQXO-910		
125.0 to 199.999MHz			IQXO-911	6 to 12 weeks	
200.0 to 325.0MHz			IQXO-912		

NOTES

IQXO-3

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Output Compatibility

- 10std TTL

Holder Style

- 8-pin DIL compatible glass filled nylon case, hermetically sealed by resin encapsulation

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 60°C

Standard Storage Temperature Range

- 0 to 60°C

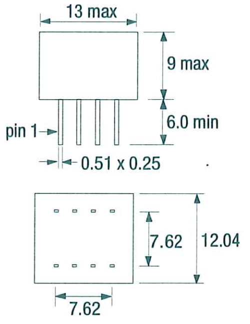
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

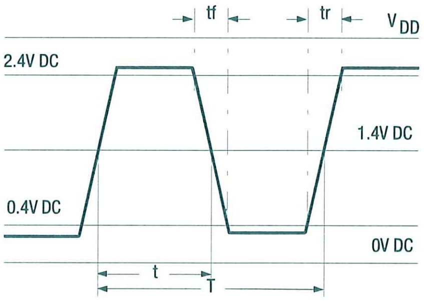
Enable/Disable Operation

- Logic '1' to pin 3 disables oscillator output
- Logic '0' to pin 3 enables oscillator output
- Normal operation requires pin 3 to be grounded

Outline

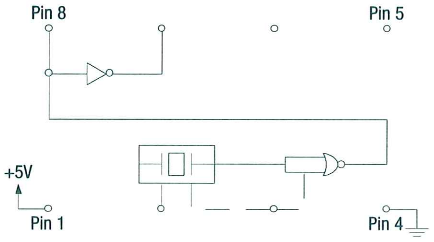


Output Waveform

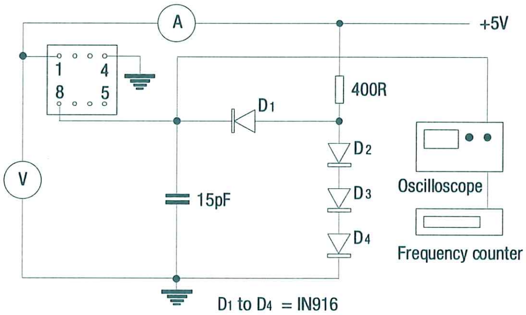


Duty cycle = t / T x 100(%)

Pin Connections



Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
8.0 to 30.0MHz	±25, ±50 & ±100ppm	5V±0.5V	40mA	15nS	15nS	40/60%	IQXO-3

IQXO-20

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Output Compatibility

- 10std TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

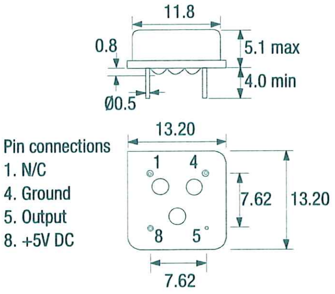
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

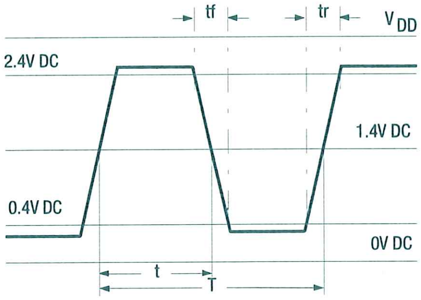
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Outline

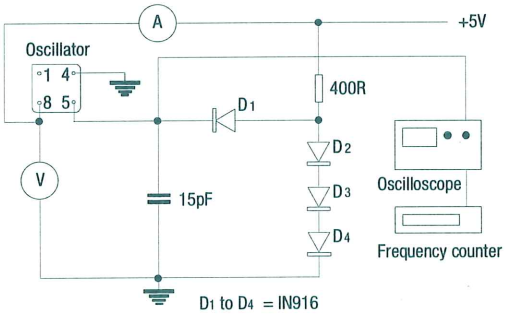


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D$_1$ to D$_4$ = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
32.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-20
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-20
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-20
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-20

IQXO-20JI

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Output Compatibility

- 10std TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

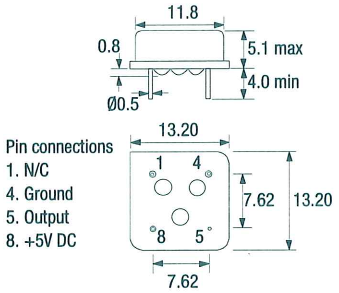
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

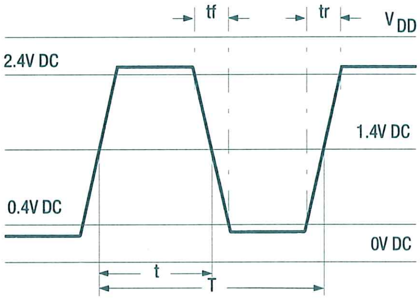
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the ‘Y_1’ plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

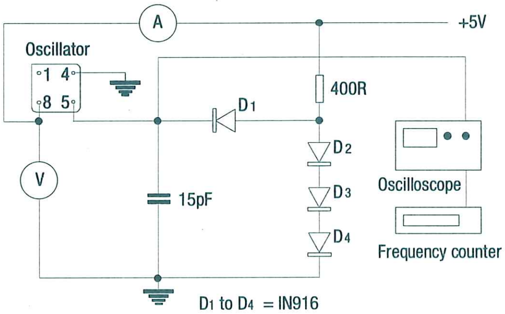


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
32.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-20JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20JI
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20JI
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-20JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-20JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-20JI

IQXO-20JM

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Output Compatibility

- 10std TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

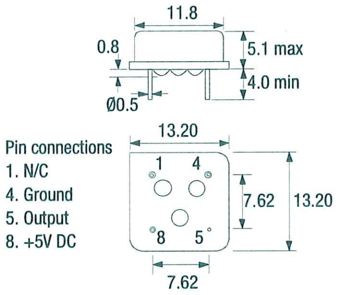
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

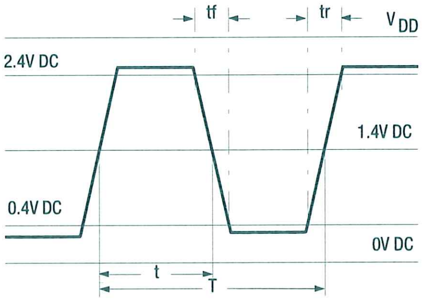
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

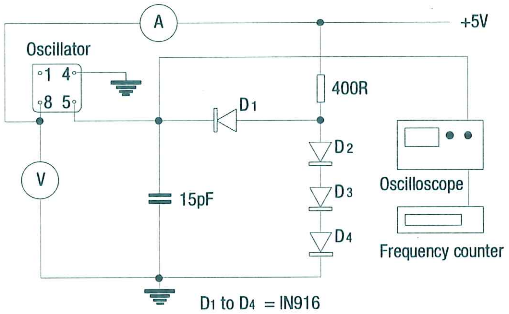


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
32.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-20JM
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20JM
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-20JM
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-20JM
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-20JM
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-20JM

IQXO-21

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Output Compatibility

- 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

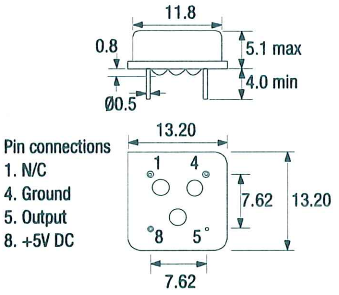
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

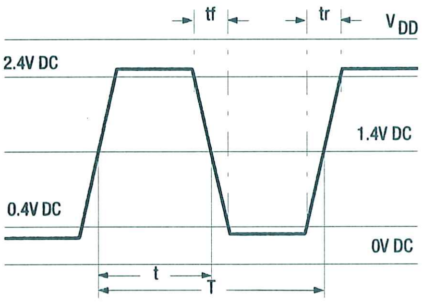
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Outline

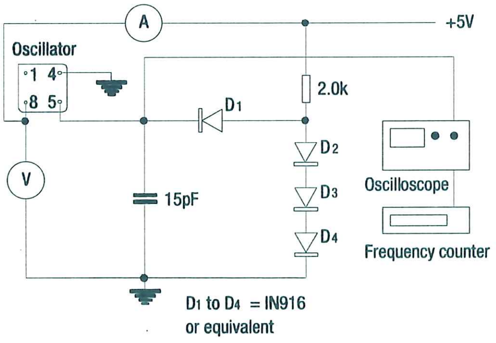


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-21
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-21
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-21
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-21

IQXO-21JI

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Output Compatibility

- 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

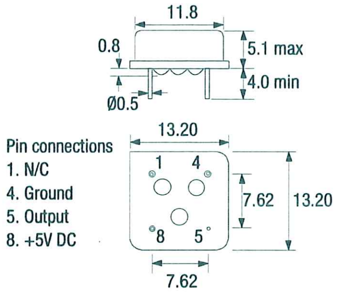
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

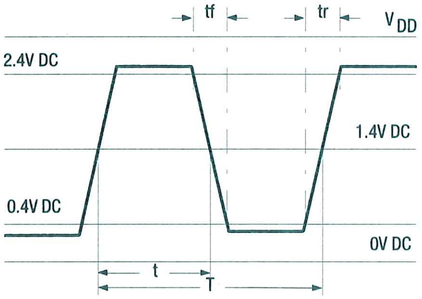
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

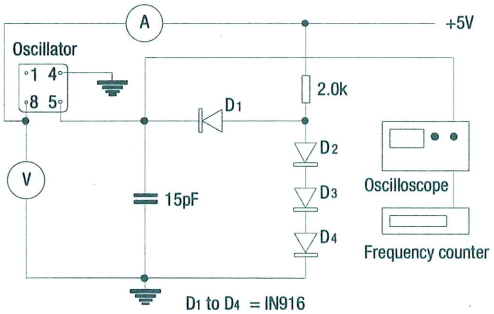


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-21JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21JI
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21JI
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-21JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-21JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-21JI

IQXO-21JM

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Output Compatibility

- 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

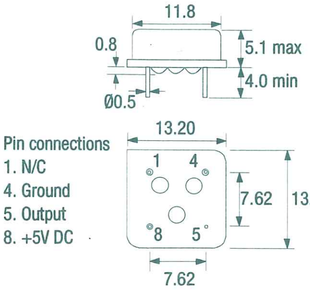
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

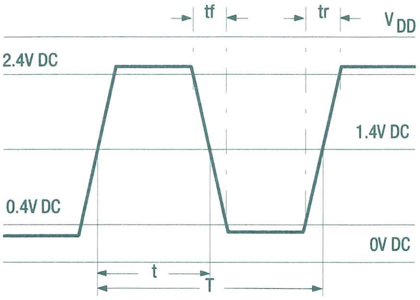
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the ‘Y$_1$’ plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7}mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

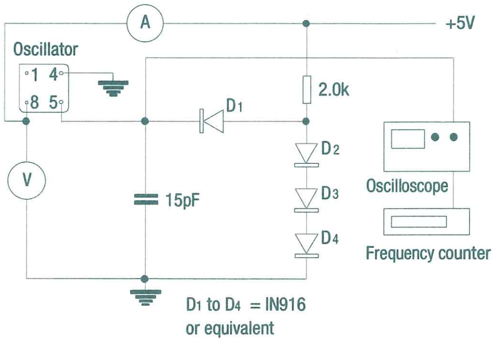


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-21JM
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21JM
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-21JM
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-21JM
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-21JM
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-21JM

IQXO-22

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Output Compatibility

- 10std HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

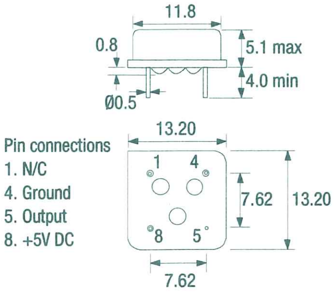
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

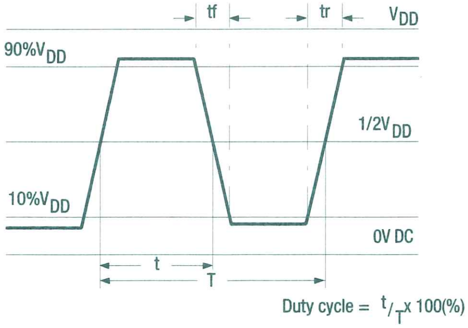
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

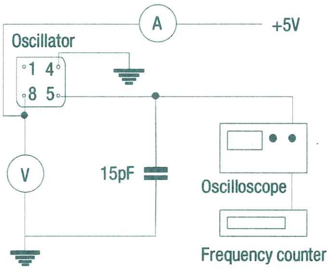
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-22
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-22
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-22
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-22

IQXO-22JI

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Output Compatibility

- 10std HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

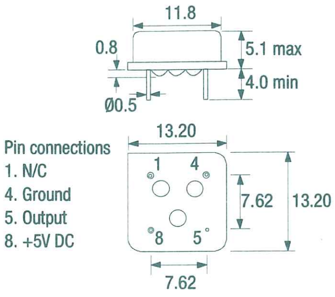
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

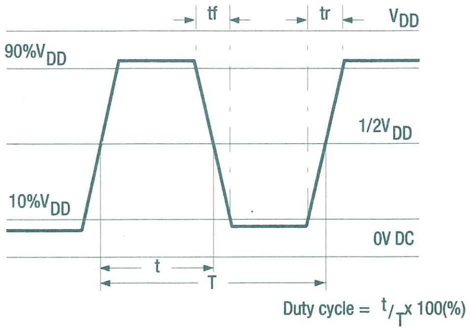
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

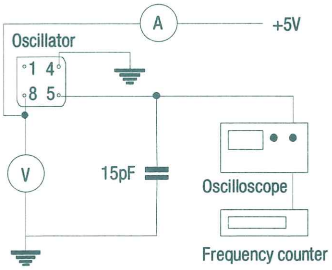
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-22JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22JI
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22JI
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-22JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-22JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-22JI

IQXO-22JM

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Output Compatibility

- 10std HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

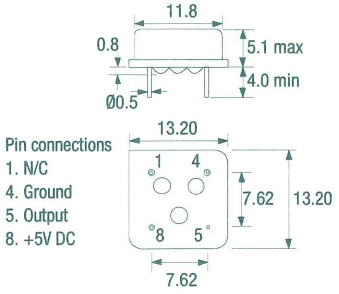
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

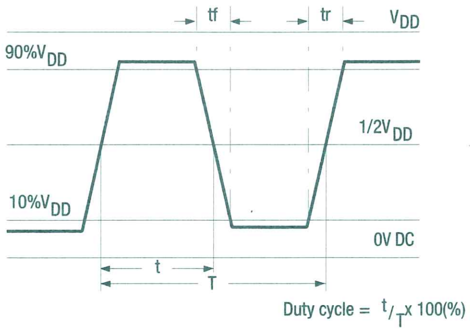
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y_1' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

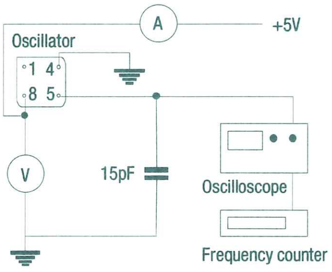
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
140.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	15mA	5nS	5nS	45/55%	IQXO-22JM
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22JM
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-22JM
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-22JM
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-22JM
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-22JM

IQXO-23

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Output Compatibility

- Tri-state HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

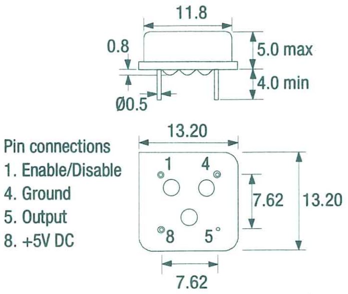
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

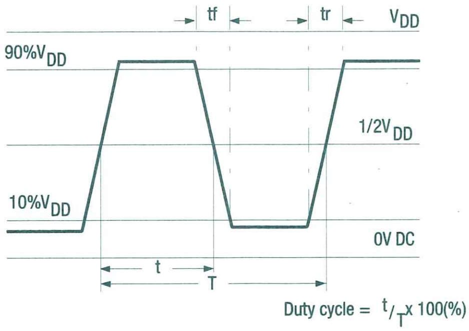
Tri-state Operation

- Logic '1' to pin 1 enables oscillator output
- Logic '0' to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum 'pull-down' resistance required to disable output =20KΩ
- Disable current at R_{max} =40µA typical
- Minimum 'pull-down' resistance required to disable output =0Ω
- Disable current at R_{min} =50µA typical

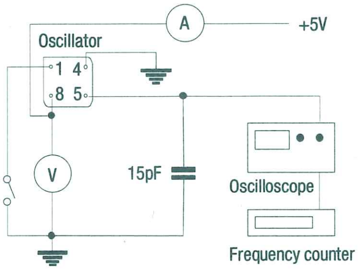
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-23
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-23
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-23

IQXO-23JI

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Output Compatibility

- Tri-state 10std HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

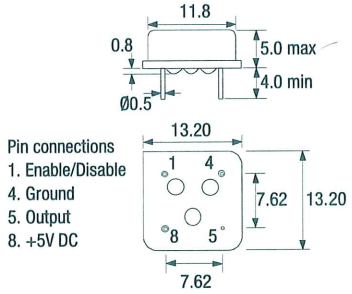
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

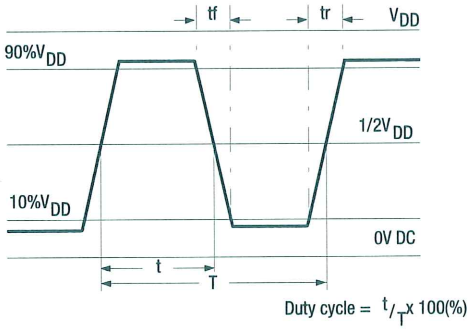
Tri-state Operation

- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

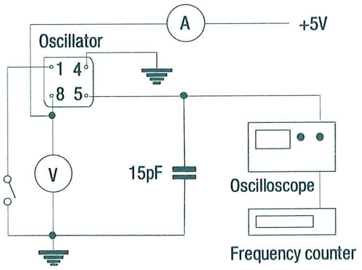
Outline



Output Waveform



Test Circuit



Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y_1' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23JI
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-23JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-23JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-23JI

IQXO-23JM

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Output Compatibility

- Tri-state 10std HCMOS

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

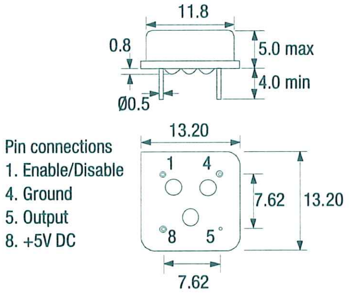
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

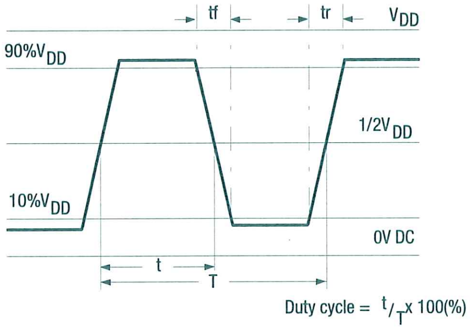
Tri-state Operation

- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

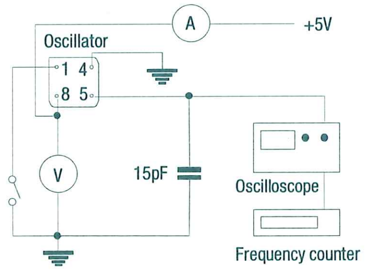
Outline



Output Waveform



Test Circuit



Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-23JM
4.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-23JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-23JM
63.0 to 80.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-23JM

IQXO-24

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Output Compatibility

- Tri-State 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

Non-Standard Frequency Tolerance at 25°C

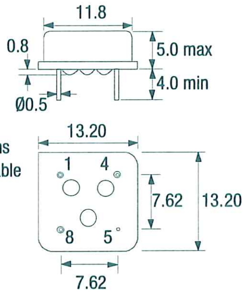
- ±5ppm, ±10ppm, ±25ppm

Tri-state Operation

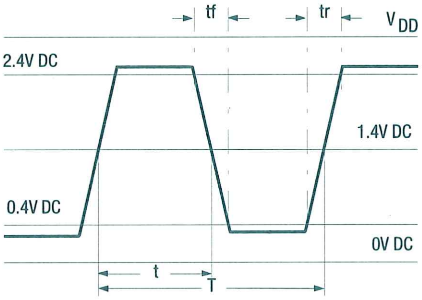
- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline

Pin connections
1. Enable/Disable
4. Ground
5. Output
8. +5V DC

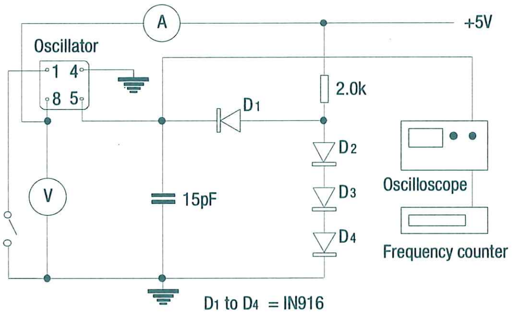


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-24
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-24
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-24

IQXO-24JI

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Output Compatibility

- Tri-state 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

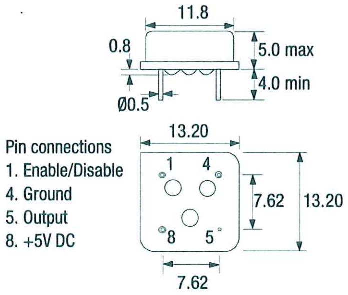
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

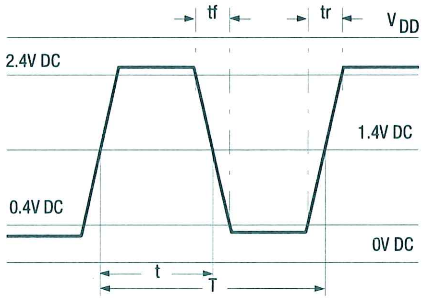
Tri-state Operation

- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline

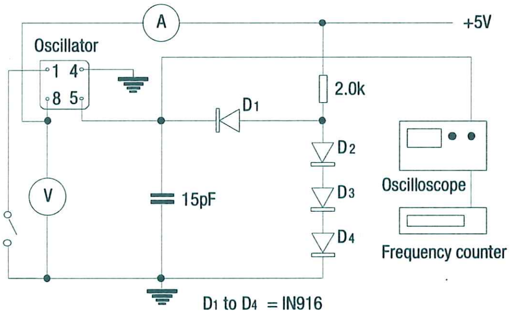


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y_1' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24JI
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-24JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-24JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-24JI

IQXO-24JM

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Output Compatibility

- Tri-state 10std LS TTL

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

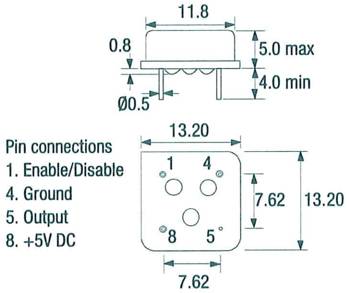
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

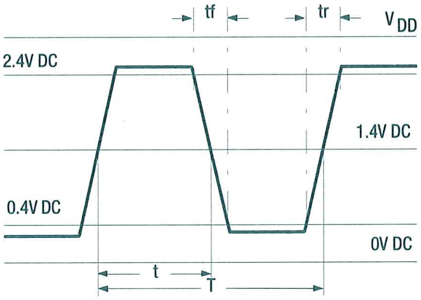
Tri-state Operation

- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline

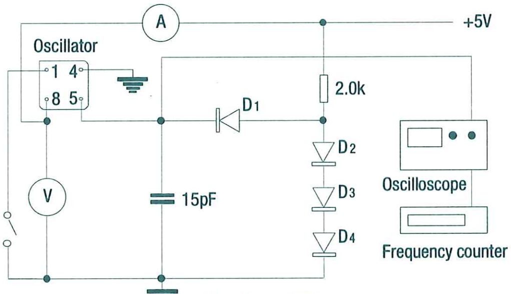


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-24JM
4.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-24JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-24JM
63.0 to 80.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-24JM

IQXO-25

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Output Compatibility

- 10std HCMOS 3.0V

Holder Style

- 8-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

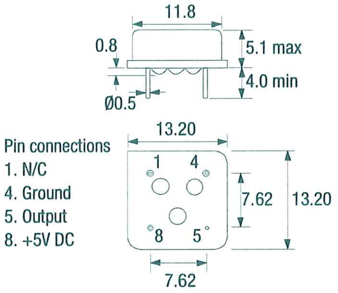
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

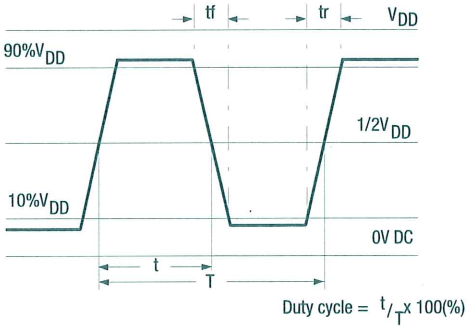
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

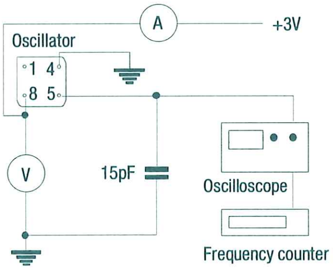
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
4.0 to 7.999MHz	±25, ±50 & ±100ppm	3V±0.3V	2mA	7nS	7nS	45/55%	IQXO-25
8.0 to 15.999MHz	±25, ±50 & ±100ppm	3V±0.3V	4mA	7nS	7nS	45/55%	IQXO-25
16.0 to 29.999MHz	±25, ±50 & ±100ppm	3V±0.3V	6mA	7nS	7nS	45/55%	IQXO-25
30.0 to 62.999MHz	±25, ±50 & ±100ppm	3V±0.3V	8mA	6nS	6nS	45/55%	IQXO-25
63.0 to 70.0MHz	±25, ±50 & ±100ppm	3V±0.3V	10mA	6nS	6nS	45/55%	IQXO-25

IQXO-32

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Output Compatibility

- 10std HCMOS

Holder Style

- 3-pin HC49/4H crystal style resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

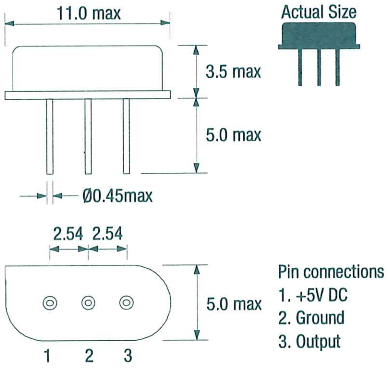
Standard Storage Temperature Range

- –55 to 125°C

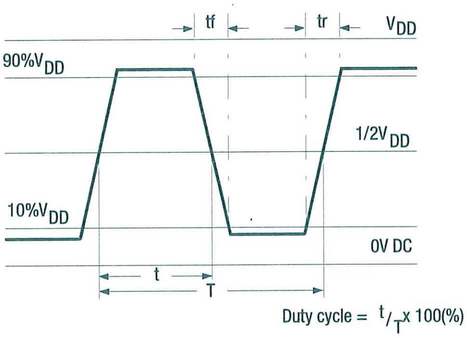
Marking

- Includes Type Number and Frequency

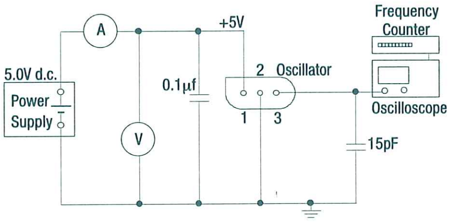
Outline (scale 2:1)



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 25.0MHz	±50ppm, ±100ppm	5V±0.5V	25mA	10nS	10nS	40/60%	IQXO-32

IQXO-100, IQXO-200, IQXO-500

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Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

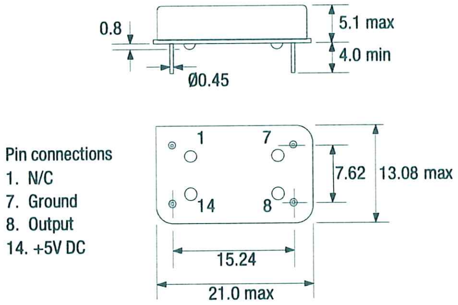
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

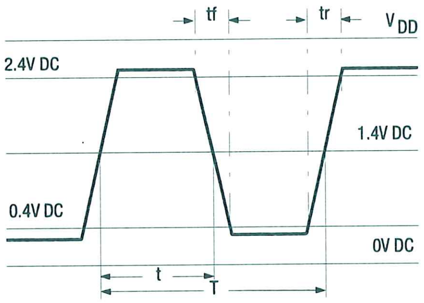
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Outline

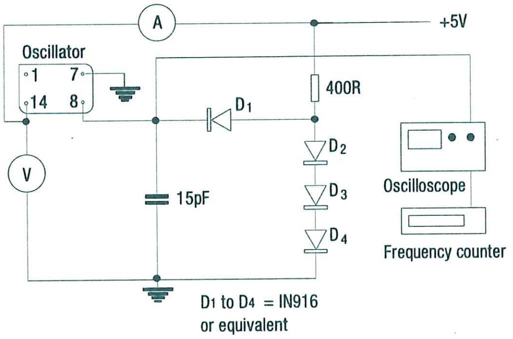


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0kHz to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	50mA	10nS	10nS	45 to 55%	IQXO-200
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	40mA	10nS	10nS	40 to 60%	IQXO-100
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	5nS	5nS	40 to 60%	IQXO-500
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	5nS	5nS	40 to 60%	IQXO-500

IQXO-100JI, IQXO-200JI, IQXO-500JI

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Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

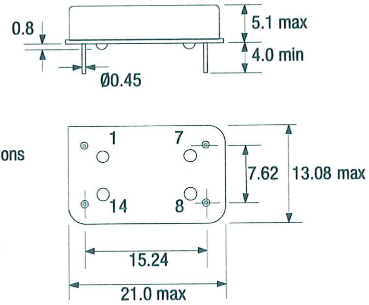
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Environmental Specification

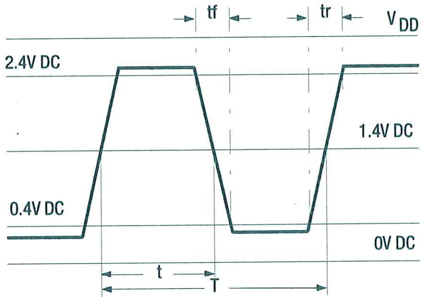
- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



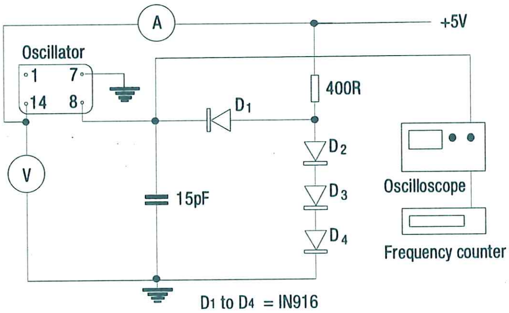
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0kHz to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	50mA	10nS	10nS	45 to 55%	IQXO-200JI
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	40mA	10nS	10nS	40 to 60%	IQXO-100JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	5nS	5nS	40 to 60%	IQXO-500JI
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	5nS	5nS	40 to 60%	IQXO-500JI

IQXO-100JM, IQXO-200JM, IQXO-500JM

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Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

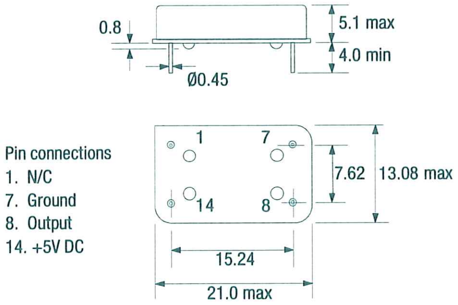
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

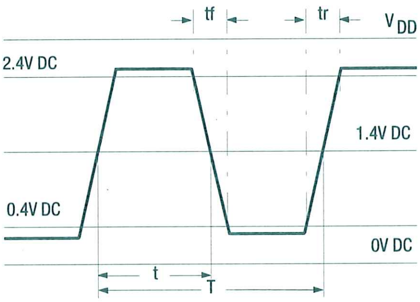
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the ‘Y_1’ plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

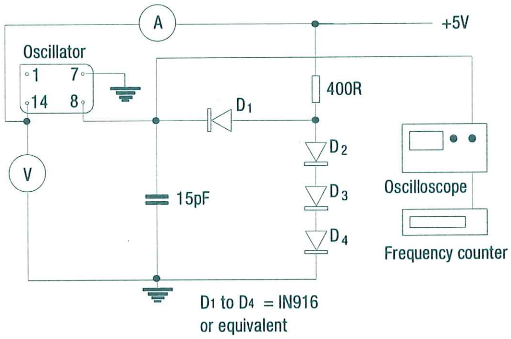


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0kHz to 3.999MHz	±50ppm, ±100ppm	5V±0.5V	50mA	10nS	10nS	45 to 55%	IQXO-200JM
4.0 to 29.999MHz	±50ppm, ±100ppm	5V±0.5V	40mA	10nS	10nS	40 to 60%	IQXO-100JM
30.0 to 62.999MHz	±50ppm, ±100ppm	5V±0.5V	60mA	5nS	5nS	40 to 60%	IQXO-500JM
63.0 to 70.0MHz	±50ppm, ±100ppm	5V±0.5V	65mA	5nS	5nS	40 to 60%	IQXO-500JM

IQXO-132

ISSUE 6; 21 MARCH 1994

Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

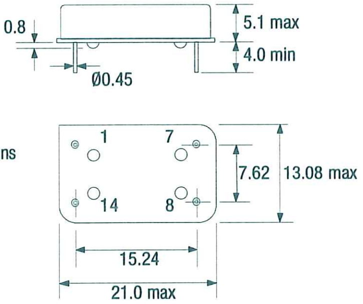
- –55 to 125°C

Marking

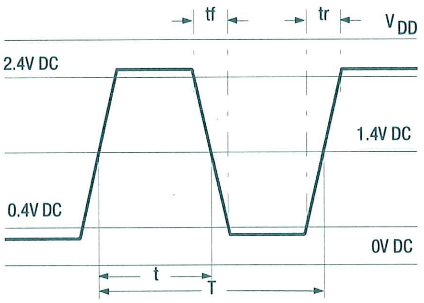
- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

Outline

Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

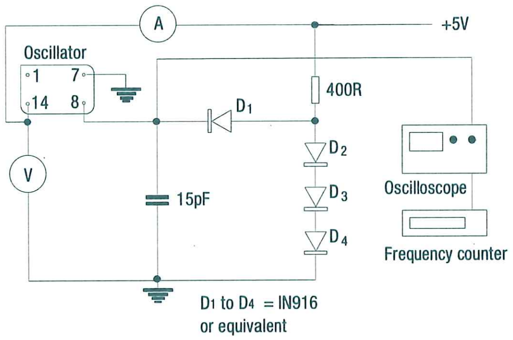


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	3nS	3nS	45 to 55%	IQXO-132

IQXO-132JI

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number, Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

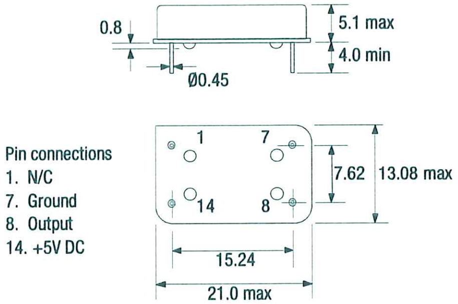
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

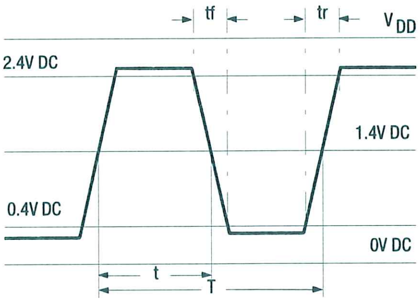
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

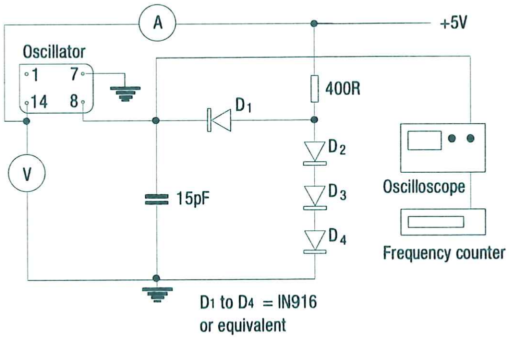


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	3nS	3nS	40 to 60%	IQXO-132JI

IQXO-132JM

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number, Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

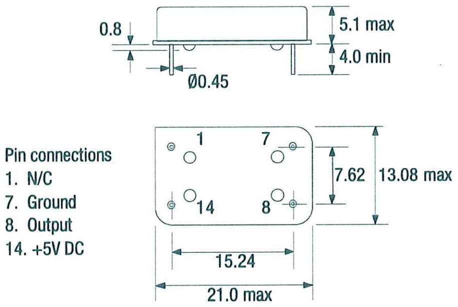
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

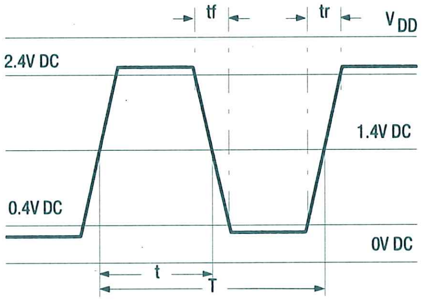
Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

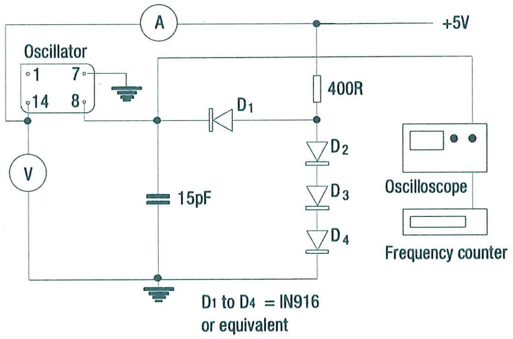


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±50ppm, ±100ppm	5V±0.5V	65mA	3nS	3nS	40 to 60%	IQXO-132JM

IQXO-133

ISSUE 4; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

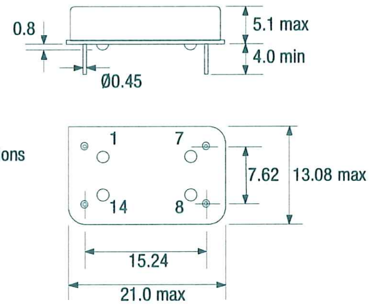
Standard Storage Temperature Range

- –55 to 125°C

Marking

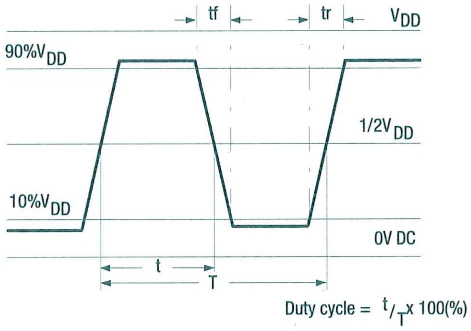
- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

Outline

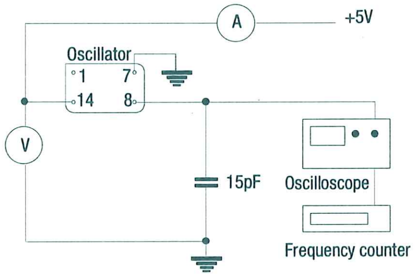


Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	3nS	3nS	40 to 60%	IQXO-133

IQXO-133JI

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number, Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

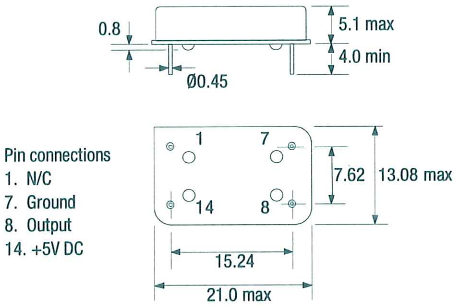
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Environmental Specification

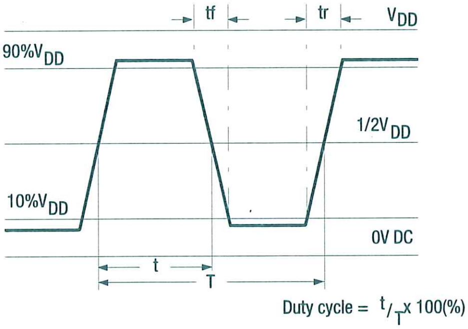
- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



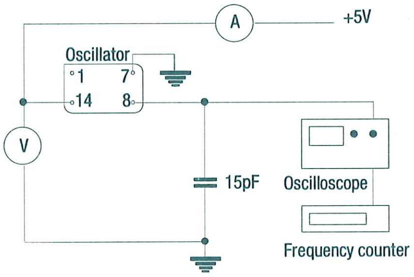
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = $^t/_T$ x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±25, ±50 & ±100ppm	5V±0.5V	65mA	3nS	3nS	40 to 60%	IQXO-133JI

IQXO-133JM

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number, Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

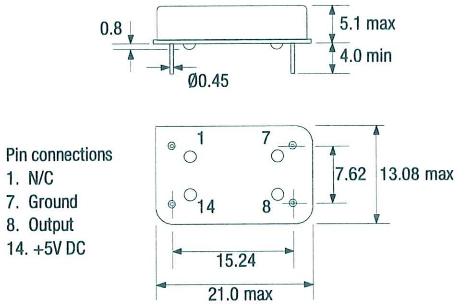
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

Environmental Specification

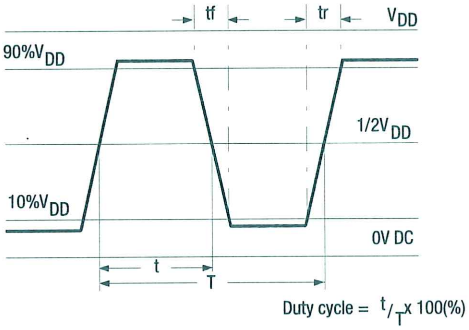
- Acceleration: 490m/S^2 for 1 minute in the 'Y_1' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

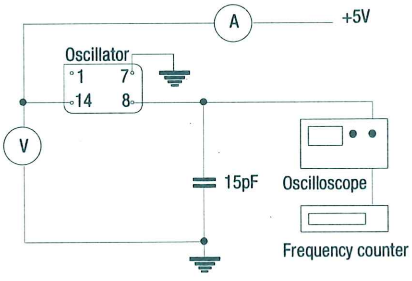


Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
70.0 to 100.0MHz	±50ppm, ±100ppm	5V±0.5V	65mA	3nS	3nS	40 to 60%	IQXO-133JM

IQXO134

ISSUE 3; 21 MARCH 1994

Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±5ppm, ±10ppm, ±15ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 50°C (±5ppm)
  0 to 70°C (±10ppm, ±15ppm)

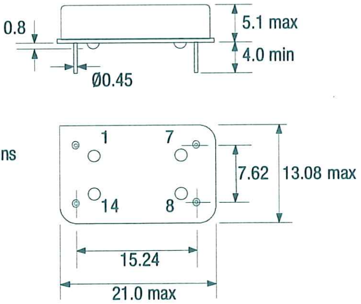
Standard Storage Temperature Range

- –55 to 125°C

Marking

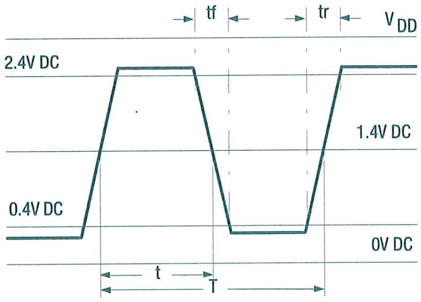
- Includes Type Number, Frequency, Date Code, Frequency Stability

Outline



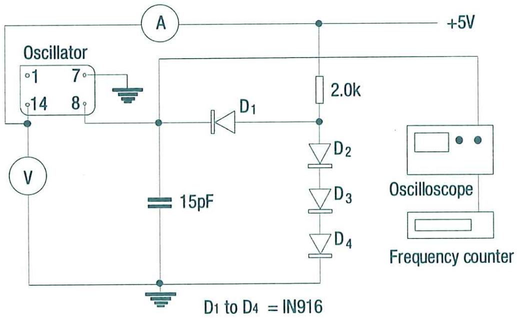
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
4.0 to 29.999MHz	±5ppm, ±10ppm & ±15ppm	5V±0.1V	20mA	5nS	5nS	45/55%	IQXO-134
30.0 to 59.999MHz	±5ppm, ±10ppm & ±15ppm	5V±0.1V	30mA	4nS	4nS	45/55%	IQXO-134
60.0 to 70.0MHz	±10ppm & ±15ppm	5V±0.1V	30mA	4nS	4nS	45/55%	IQXO-134

IQXO-135

ISSUE 4; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±5ppm, ±10ppm, ±15ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 50°C (±5ppm)
  0 to 70°C (±10ppm, ±15ppm)

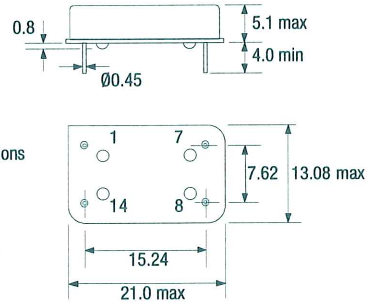
Standard Storage Temperature Range

- –55 to 125°C

Marking

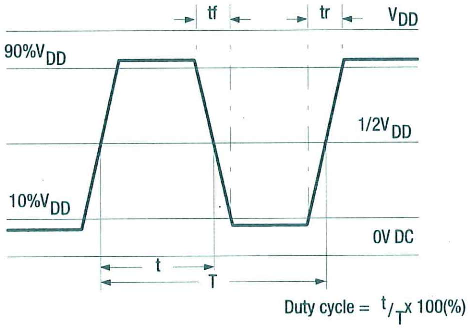
- Includes Type Number, Frequency, Date Code, Frequency Stability

Outline

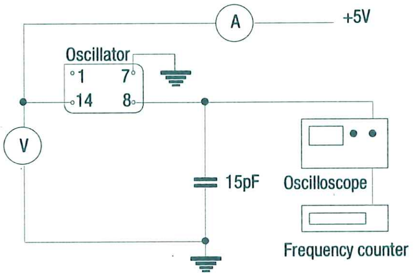


Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
4.0 to 29.999MHz	±5ppm, ±10ppm & ±15ppm	5V±0.1V	20mA	5nS	5nS	45/55%	IQXO-135
30.0 to 59.999MHz	±5ppm, ±10ppm & ±15ppm	5V±0.1V	30mA	4nS	4nS	45/55%	IQXO-135
60.0 to 70.0MHz	±10ppm & ±15ppm	5V±0.1V	30mA	4nS	4nS	45/55%	IQXO-135

IQXO-139; -140; -141; -142; -143

ISSUE 3; 21 MARCH 1994

Output Compatibility

- Tri-state 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

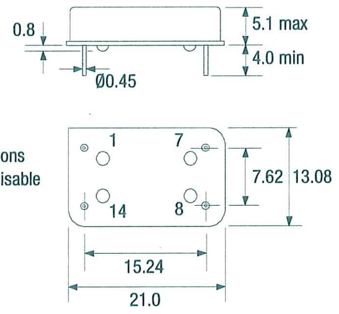
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Tri-state Operation

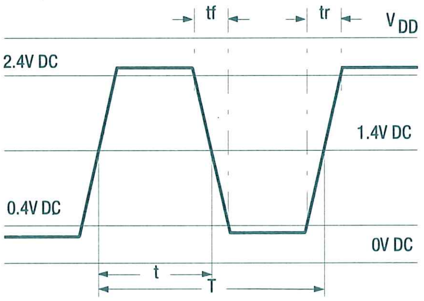
- Logic '1' to pin 1 enables oscillator output
- Logic '0' to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum 'pull-down' resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum 'pull-down' resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline



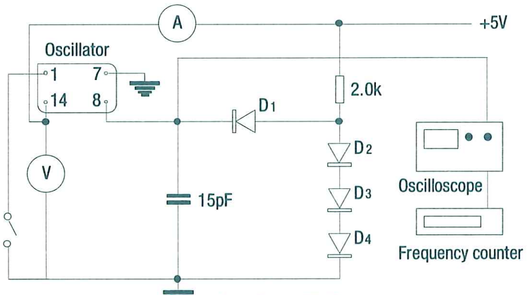
Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-139
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-140
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-141
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-142
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-143

IQXO-139JI; -140JI; -141JI; -142JI; -143JI

ISSUE 3; 21 MARCH 1994

Output Compatibility

- Tri-state 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

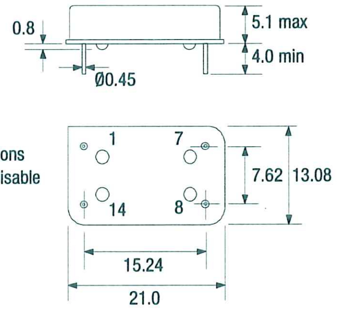
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Tri-state Operation

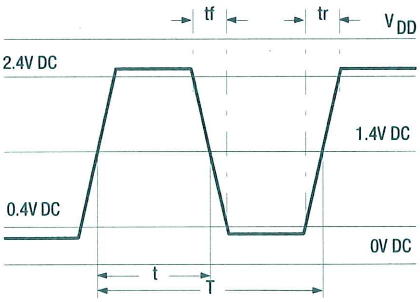
- Logic '1' to pin 1 enables oscillator output
- Logic '0' to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum 'pull-down' resistance required to disable output =20KΩ
- Disable current at R_{max} =40µA typical
- Minimum 'pull-down' resistance required to disable output =0Ω
- Disable current at R_{min} =50µA typical

Outline



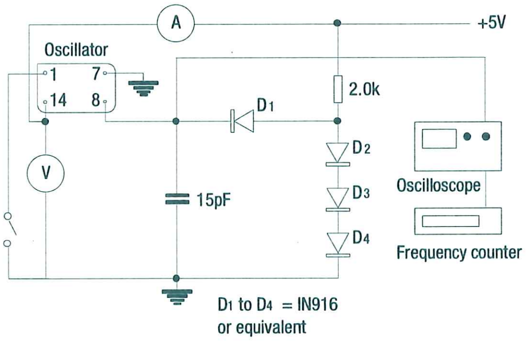
Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	**Frequency Stability**	**Supply Voltage**	**Supply Current**	**Rise Time (t_r)**	**Fall Time (t_f)**	**Duty Cycle**	**Model Number**
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-139JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-140JI
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-141JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-142JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-143JI

IQXO-139JM; -140JM; -141JM; -142JM; -143JM

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Output Compatibility

- Tri-state 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

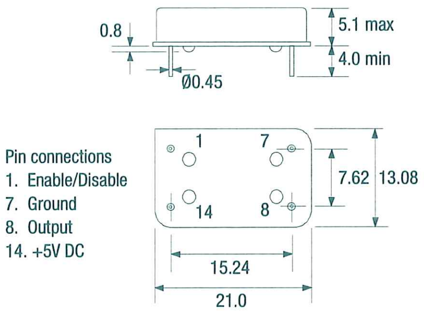
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

Tri-state Operation

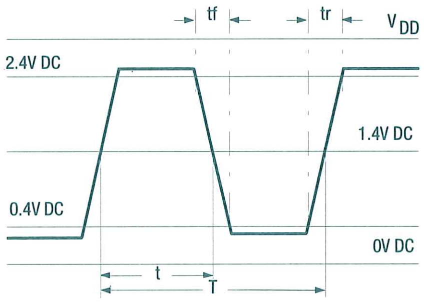
- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline



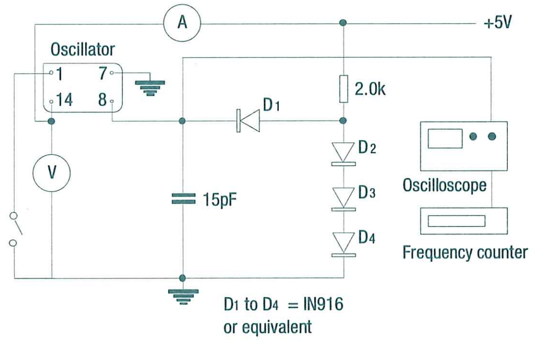
Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D_1 to D_4 = IN916
or equivalent

Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-139JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-140JM
4.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-141JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-142JM
63.0 to 80.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-143JM

IQXO-149; -150; -151; -152; -153

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Output Compatibility

- Tri-state 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

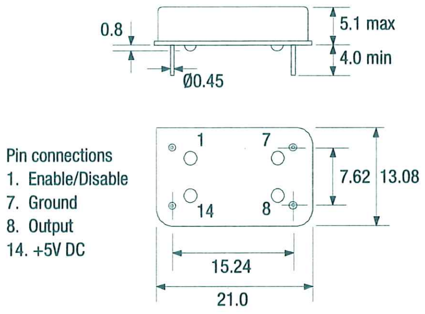
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Tri-state Operation

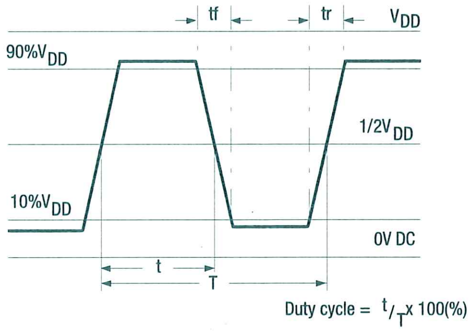
- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline



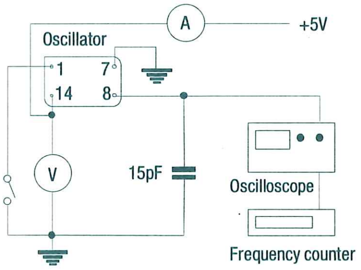
Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = $^{t}/_{T}$ x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-149
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-150
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-151
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-152
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-153

IQXO-149JI; -150JI; -151JI; -152JI; -153JI

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Output Compatibility

- Tri-state 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

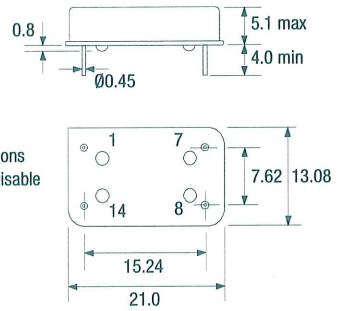
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Tri-state Operation

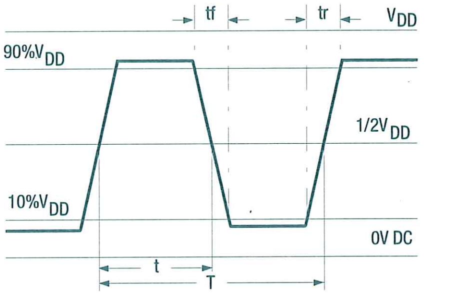
- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40µA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50µA typical

Outline



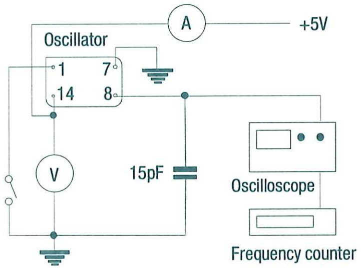
Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = $^{t}/_{T}$ x 100(%)

Test Circuit



Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-149JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-150JI
4.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-151JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-152JI
63.0 to 80.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-153JI

IQXO-149JM; -150JM; -151JM; -152JM; -153JM

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Output Compatibility

- Tri-state 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

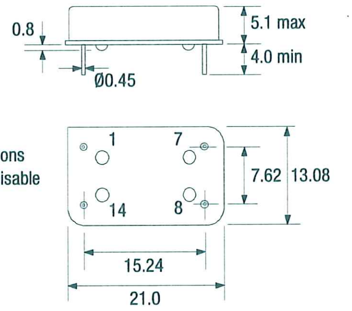
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

Tri-state Operation

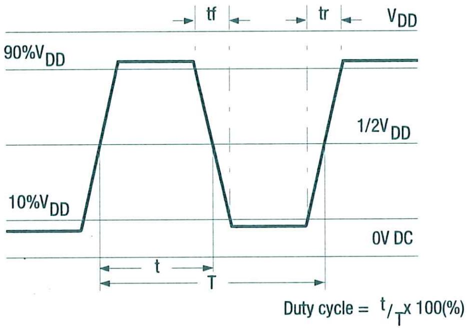
- Logic ‘1’ to pin 1 enables oscillator output
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- No connection to pin 1 enables oscillator output
- Maximum ‘pull-down’ resistance required to disable output =20KΩ
- Disable current at R_{max} =40μA typical
- Minimum ‘pull-down’ resistance required to disable output =0Ω
- Disable current at R_{min} =50μA typical

Outline

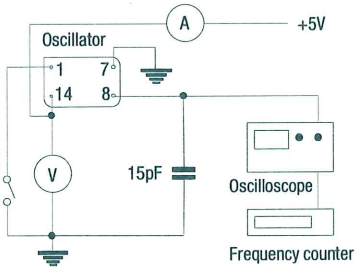


Pin connections
1. Enable/Disable
7. Ground
8. Output
14. +5V DC

Output Waveform



Test Circuit



Environmental Specification

- Acceleration: 490m/S^2 for 1 minute in the 'Y_1' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-149JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-150JM
4.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-151JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-152JM
63.0 to 80.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-153JM

IQXO-163

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Output Compatibility

- 10std HCMOS 3.0V

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

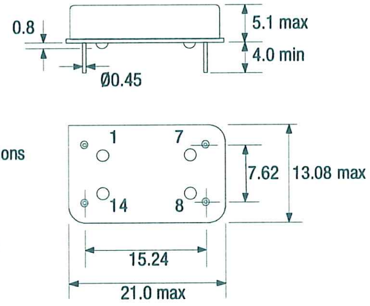
Standard Storage Temperature Range

- –55 to 125°C

Marking

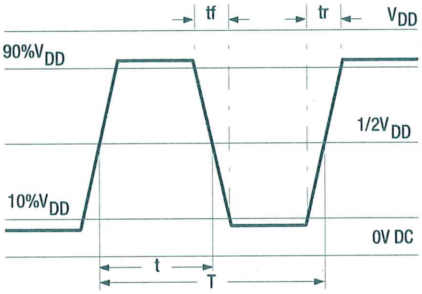
- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

Outline



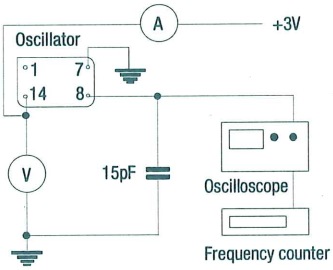
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = $^{t}/_{T}$ x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
4.0 to 7.999MHz	±25, ±50 & ±100ppm	3V±0.3V	2mA	7nS	7nS	45/55%	IQXO-163
8.0 to 15.999MHz	±25, ±50 & ±100ppm	3V±0.3V	4mA	7nS	7nS	45/55%	IQXO-163
16.0 to 29.999MHz	±25, ±50 & ±100ppm	3V±0.3V	6mA	7nS	7nS	45/55%	IQXO-163
30.0 to 62.999MHz	±25, ±50 & ±100ppm	3V±0.3V	8mA	6nS	6nS	45/55%	IQXO-163
63.0 to 70.0MHz	±25, ±50 & ±100ppm	3V±0.3V	10mA	6nS	6nS	45/55%	IQXO-163

IQXO-350

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Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

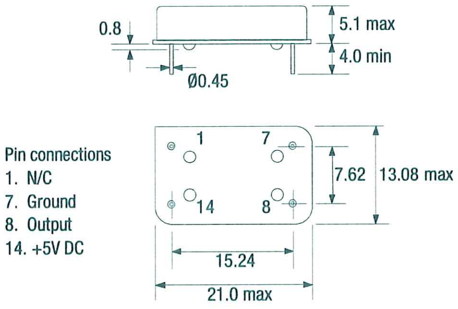
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

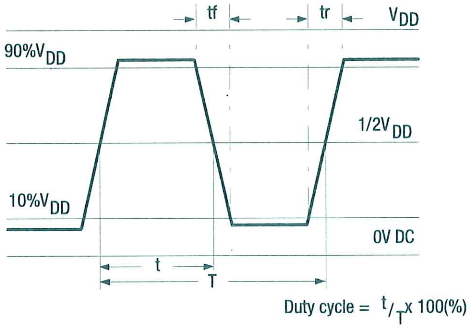
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm (250kHz to 70.0MHz only)

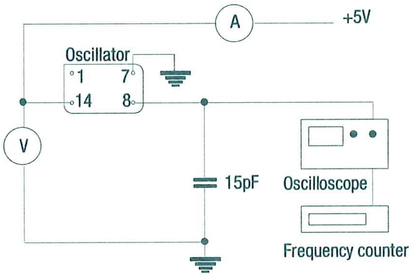
Outline



Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
7.8 to 249.999kHz	±25, ±50 & ±100ppm	5V±0.5V	50mA	10nS	10nS	40/60%	IQXO-350
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-350
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-350
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-350
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-350

IQXO-350JI

ISSUE 4; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

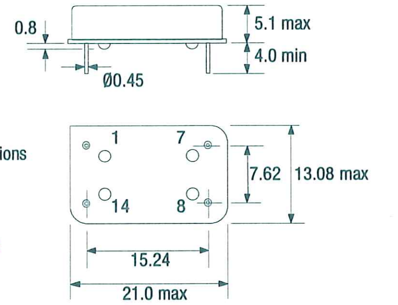
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Environmental Specification

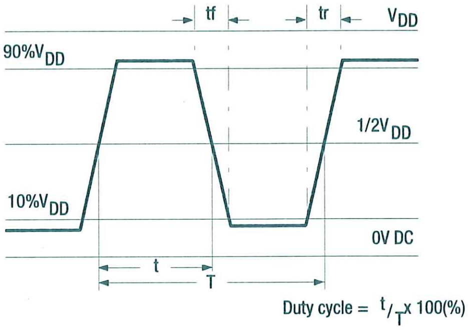
- Acceleration: $490\,\mathrm{m/S}^2$ for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at $390\,\mathrm{m/S}^2$ in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1×10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: $981\,\mathrm{m/S}^2$ for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz $98.1\,\mathrm{m/S}^2$ acceleration, 30 minutes in each of three mutually perpendicular planes

Outline

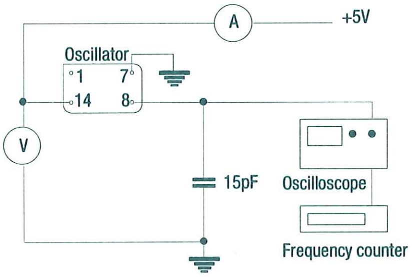


Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350JI
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-350JI
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-350JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-350JI
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-350JI

IQXO-350JM

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Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

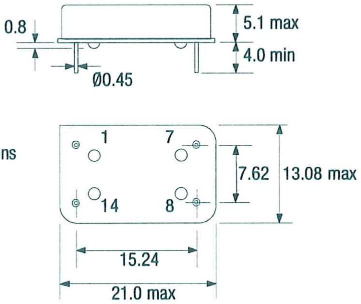
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

Environmental Specification

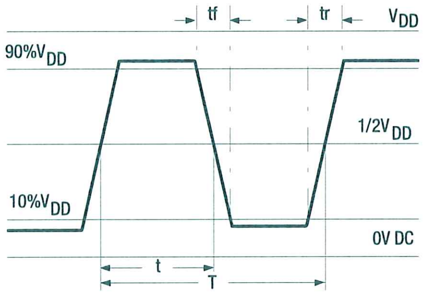
- Acceleration: 490m/S^2 for 1 minute in the ‘Y_1’ plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



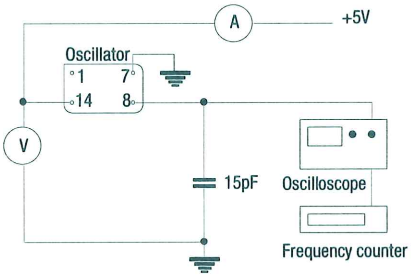
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = $^t/_T$ x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-350JM
4.0 to 15.999MHz	±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-350JM
16.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-350JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-350JM
63.0 to 70.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-350JM

IQXO-351

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Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

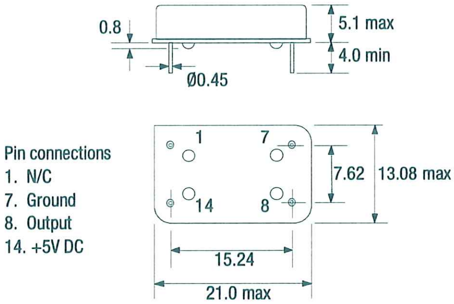
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm) and non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code

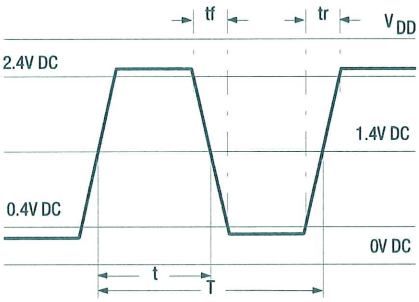
Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

Outline

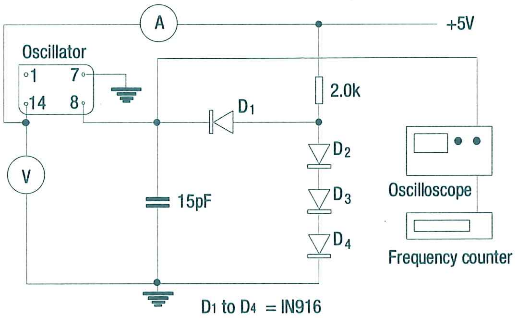


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D_1 to D_4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-351
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-351
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-351
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-351

IQXO-351JI

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Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±25ppm or ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

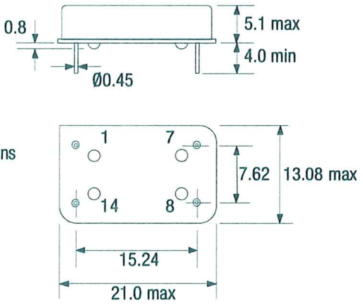
Non-Standard Testing

- Dynamic burn-in for 168hrs at 90°C

Environmental Specification

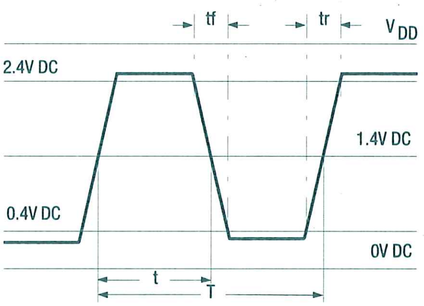
- Acceleration: 490m/S^2 for 1 minute in the ‘Y$_1$’ plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



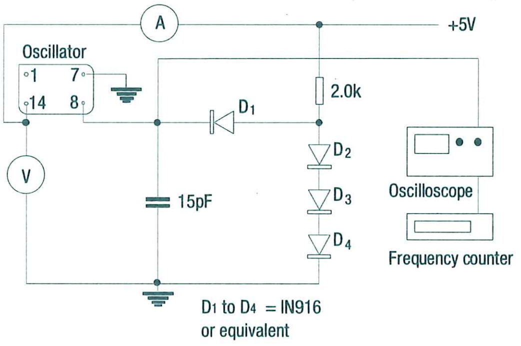
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351JI
1.0 to 3.999MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351JI
4.0 to 15.999MHz	±25, ±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-351JI
16.0 to 29.999MHz	±25, ±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-351JI
30.0 to 62.999MHz	±25, ±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-351JI
63.0 to 70.0MHz	±25, ±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-351JI

IQXO-351JM

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Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- –55 to 125°C

Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number with letter code identifying non-standard frequency tolerances (D=±5ppm, E=±10ppm, F=±25ppm), Frequency, Date Code and, if the ±50ppm version is specified, Frequency Stability.

Non-Standard Frequency Tolerance at 25°C

- ±5ppm, ±10ppm, ±25ppm

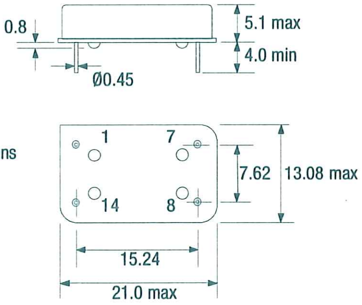
Non-Standard Testing

- Dynamic burn-in for 168hrs at 125°C

Environmental Specification

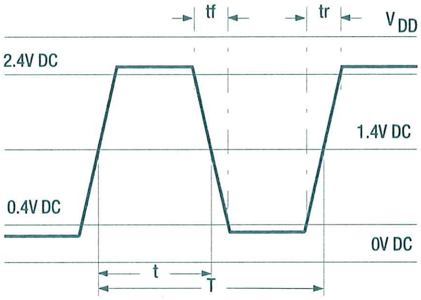
- Acceleration: 490m/S^2 for 1 minute in the 'Y$_1$' plane
- Bump: 4000 bumps at 390m/S^2 in each of three mutually perpendicular planes
- Hermetic Seal: not to exceed 1 x 10^{-7} mBar litres of Helium
- Humidity: 85% relative humidity at 85°C for 250 hours
- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Solderability: BS2011 test TA
- Thermal Shock: 10 cycles from –55 to 125°C
- Vibration: 10 to 60Hz 0.75 displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



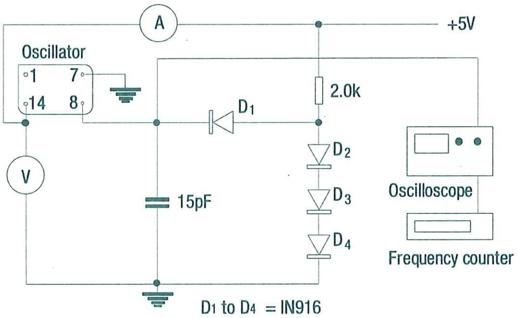
Pin connections
1. N/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
250.0 to 999.999kHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351JM
1.0 to 3.999MHz	±50 & ±100ppm	5V±0.5V	30mA	5nS	5nS	45/55%	IQXO-351JM
4.0 to 15.999MHz	±50 & ±100ppm	5V±0.5V	10mA	5nS	5nS	45/55%	IQXO-351JM
16.0 to 29.999MHz	±50 & ±100ppm	5V±0.5V	20mA	5nS	5nS	45/55%	IQXO-351JM
30.0 to 62.999MHz	±50 & ±100ppm	5V±0.5V	25mA	4nS	4nS	45/55%	IQXO-351JM
63.0 to 70.0MHz	±50 & ±100ppm	5V±0.5V	30mA	4nS	4nS	45/55%	IQXO-351JM

IQXO-899, -900, -901, -902

ISSUE 4; 21 MARCH 1994

Output Compatibility

- 5std ECL 10kH

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

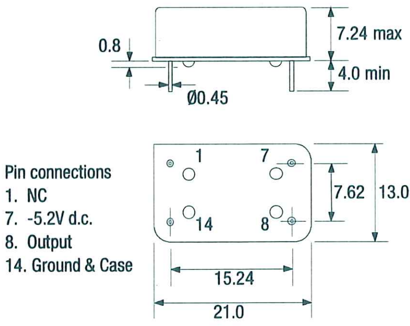
Standard Storage Temperature Range

- –55 to 125°C

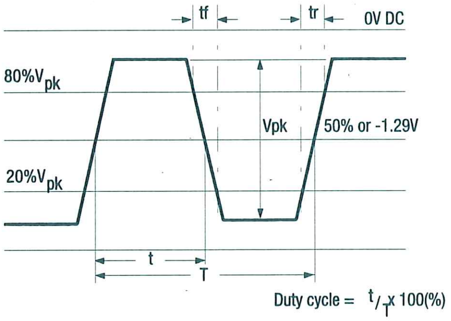
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

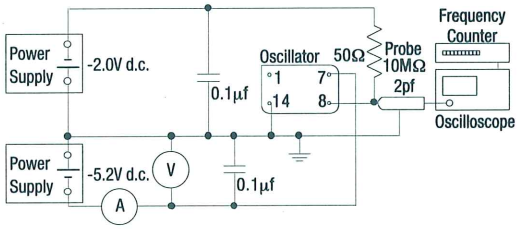
Outline



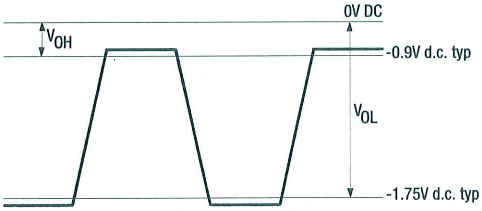
Output Waveform



Test Circuit



Logic Levels



Logic 0 (V_{OL}) minimum -1.87V; maximum -1.625V
Logic 1 (V_{OH}) minimum -1.06V; maximum -0.72V

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
30.0 to 69.999MHz	±25, ±50 & ±100ppm	–5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-899
70.0 to 124.999MHz	±25, ±50 & ±100ppm	–5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-900
125.0 to 199.999MHz	±25, ±50 & ±100ppm	–5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-901
200.0 to 325.0MHz	±25, ±50 & ±100ppm	–5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-902

Note: Output requires termination either 270 ohms to ground or 50 ohms to –2.0V d.c.

IQXO-904, -905, -906, -907

ISSUE 5; 21 MARCH 1994

Output Compatibility

- 5std ECL 10kH

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

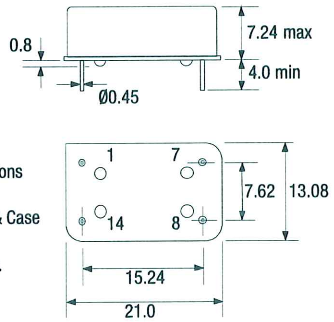
Standard Storage Temperature Range

- –55 to 125°C

Marking

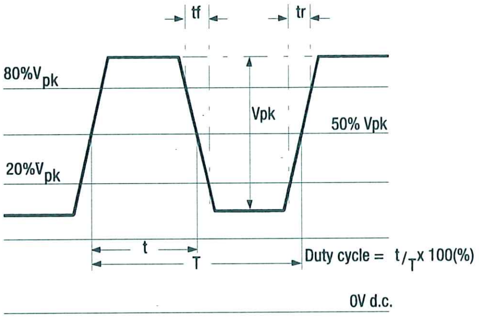
- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

Outline

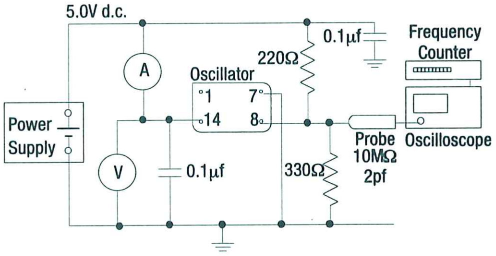


Pin connections
1. NC
7. Ground & Case
8. Output
14. 5.0V d.c.

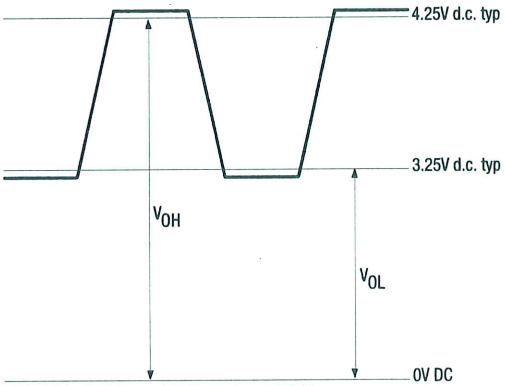
Output Waveform



Test Circuit



Logic Levels



Logic 0 (V_{OL}) minimum 3.05V; maximum 3.42V
Logic 1 (V_{OH}) minimum 4.0V; maximum 4.45V

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
30.0 to 69.999MHz	±25, ±50 & ±100ppm	5.0V±0.5V	60mA	2nS	2nS	40/60%	IQXO-904
70.0 to 124.999MHz	±25, ±50 & ±100ppm	5.0V±0.5V	60mA	2nS	2nS	40/60%	IQXO-905
125.0 to 199.999MHz	±25, ±50 & ±100ppm	5.0V±0.5V	60mA	2nS	2nS	40/60%	IQXO-906
200.0 to 325.0MHz	±25, ±50 & ±100ppm	5.0V±0.5V	60mA	2nS	2nS	40/60%	IQXO-907

Note: Output requires termination either 270 ohms to Ground or 50 ohms to 3.0V d.c.

IQXO-909, -910, -911, -912

ISSUE 4; 21 MARCH 1994

Output Compatibility

- Dual Complementary 5std ECL 10kH

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

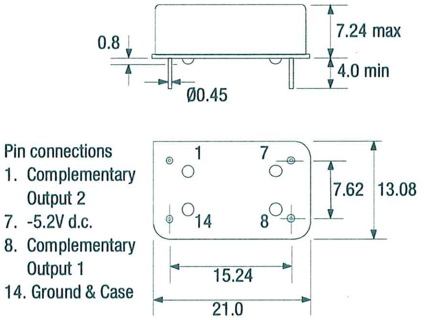
Standard Storage Temperature Range

- –55 to 125°C

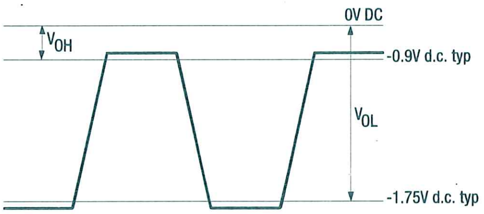
Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

Outline - 14-pin DIL

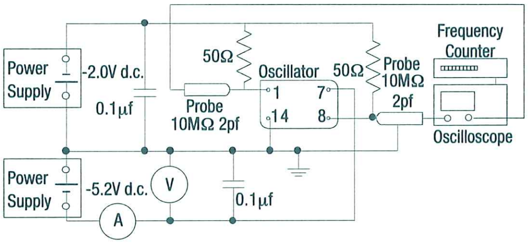


Logic Levels



Logic 0 (V_{OL}) minimum -1.87V; maximum -1.625V
Logic 1 (V_{OH}) minimum -1.06V; maximum -0.72V

Test Circuit

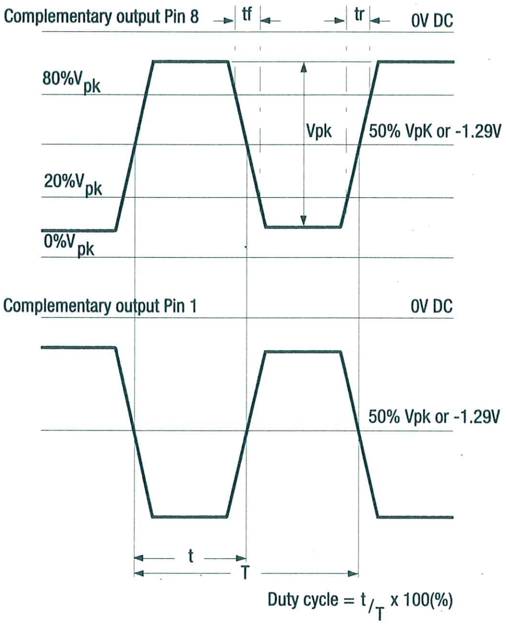


Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
30.0 to 69.999MHz	±25, ±50 & ±100ppm	−5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-909
70.0 to 124.999MHz	±25, ±50 & ±100ppm	−5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-910
125.0 to 199.999MHz	±25, ±50 & ±100ppm	−5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-911
200.0 to 325.0MHz	±25, ±50 & ±100ppm	−5.2V±0.25V	60mA	2nS	2nS	40/60%	IQXO-912

Note: Both complementary outputs require terminating to either 270 ohms to ground or 50 ohms to −2.0V d.c.

Output Waveform



Duty cycle = $t/_T$ x 100(%)

IQXO-919, -920, -921, -922

ISSUE 2; 21 MARCH 1994

Output Compatibility

- Dual Complementary 5std ECL 10kH

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

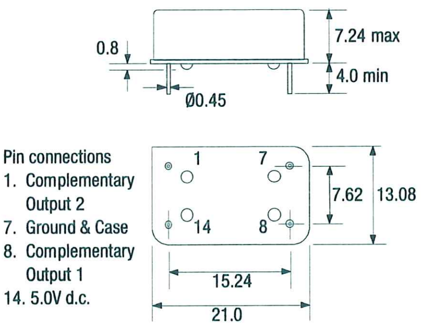
Standard Storage Temperature Range

- –55 to 125°C

Marking

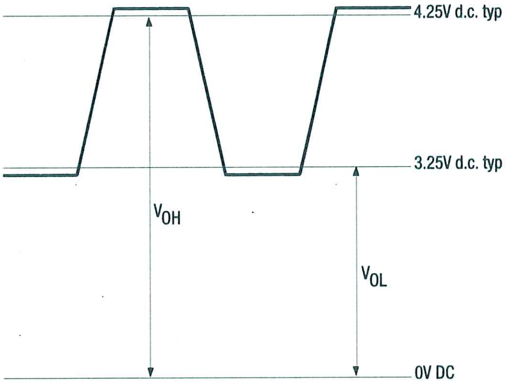
- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

Outline - 14-pin DIL



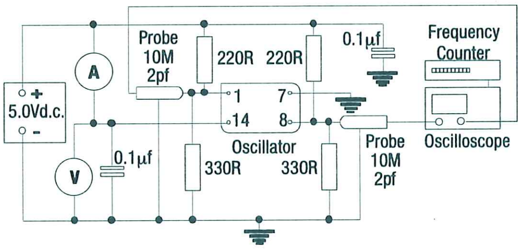
Pin connections
1. Complementary Output 2
7. Ground & Case
8. Complementary Output 1
14. 5.0V d.c.

Logic Levels



Logic 0 (V_{OL}) minimum 3.05V; maximum 3.42V
Logic 1 (V_{OH}) minimum 4.0V; maximum 4.45V

Test Circuit

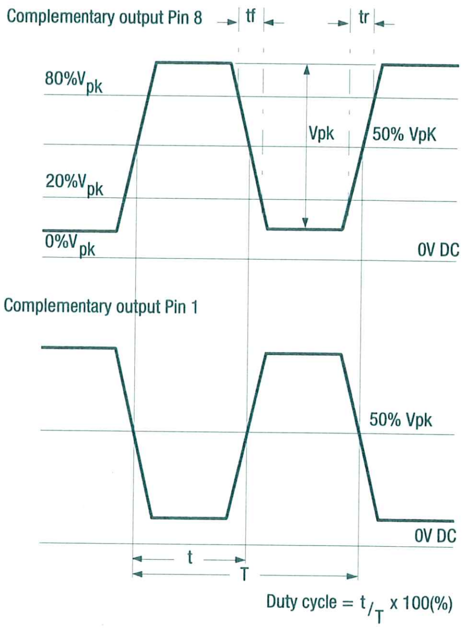


Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
30.0 to 69.999MHz	±25, ±50 & ±100ppm	5.0V±0.25V	60mA	2nS	2nS	40/60%	IQXO-919
70.0 to 124.999MHz	±25, ±50 & ±100ppm	5.0V±0.25V	60mA	2nS	2nS	40/60%	IQXO-920
125.0 to 199.999MHz	±25, ±50 & ±100ppm	5.0V±0.25V	60mA	2nS	2nS	40/60%	IQXO-921
200.0 to 325.0MHz	±25, ±50 & ±100ppm	5.0V±0.25V	60mA	2nS	2nS	40/60%	IQXO-922

Note: Both complementary outputs require terminating to either 270 ohms to Ground or 50 ohms to 3.0V d.c.

Output Waveform


Complementary output Pin 8
tf
tr
80%Vpk
20%Vpk
0%Vpk
Vpk
50% VpK
0V DC
Complementary output Pin 1
50% Vpk
0V DC
t
T
Duty cycle = t/T x 100(%)

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IQVCXO-180 172

NOTES

VCXOs - Delivery Options

HCMOS Voltage Controlled Crystal Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Output Frequency Change	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 24.0MHz	±25ppm	±50ppm min	0 to 70°C	IQVCXO-172	10 to 12 weeks	162
	±25ppm to ±50ppm	±100ppm min		IQVCXO-173		164
	±50ppm to ±100ppm	±200ppm min		IQVCXO-174		166

LS TTL Voltage Controlled Crystal Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Output Frequency Change	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 24.0MHz	±25ppm	±50ppm min	0 to 70°C	IQVCXO-178	10 to 12 weeks	168
	±25ppm to ±50ppm	±100ppm min		IQVCXO-179		170
	±50ppm to ±100ppm	±200ppm min		IQVCXO-180		172

IQVCXO-172

ISSUE 2; 21 MARCH 1993

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm @ V_C=2.5V
(inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (A=±25ppm), Frequency, Date Code

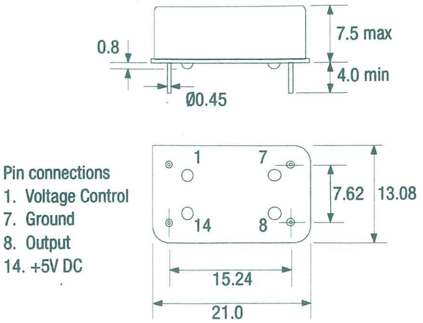
Output Frequency Change

- ±50ppm min

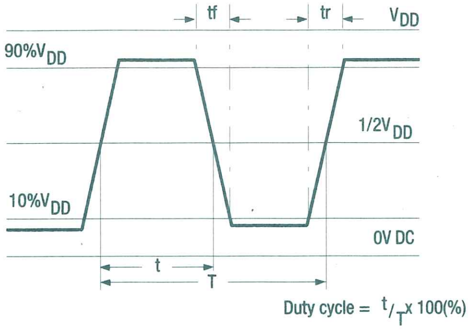
Voltage Control Pin 1

- 2.5V ±2.0V

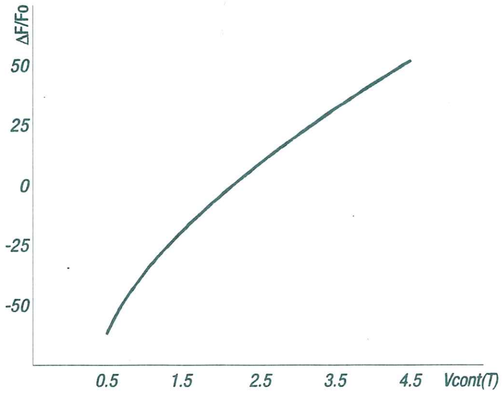
Outline



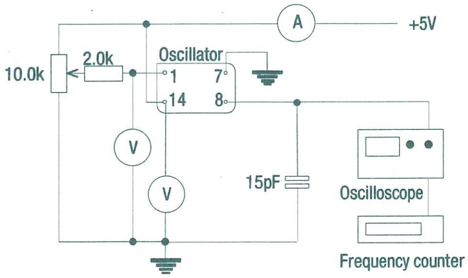
Output Waveform



Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±25ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-172

IQVCXO-173

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, @ V_C=2.5V (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm), Frequency, Date Code

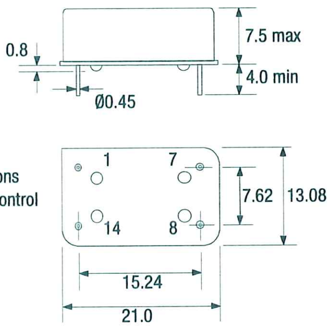
Output Frequency Change

- ±100ppm min

Voltage Control Pin 1

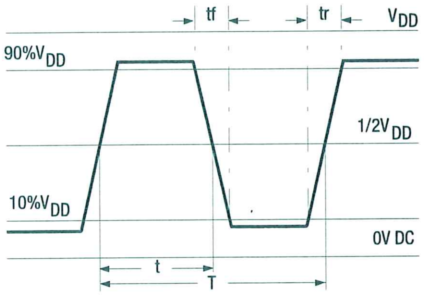
- 2.5V ±2.0V

Outline



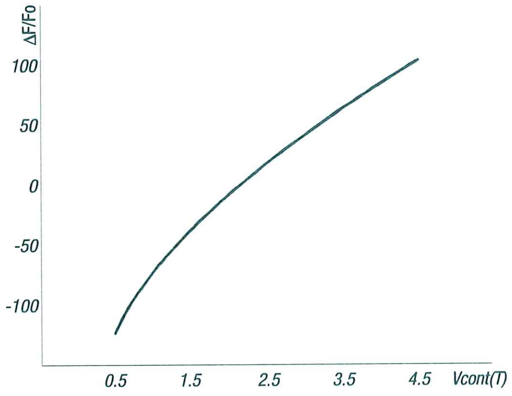
Pin connections
1. Voltage Control
7. Ground
8. Output
14. +5V DC

Output Waveform

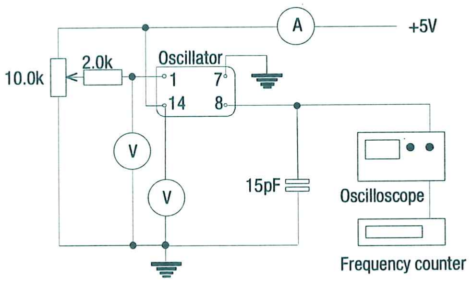


Duty cycle = $^{t}/_{T}$x 100(%)

Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±25ppm, ±50ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-173

IQVCXO-174

ISSUE 2; 21 MARCH 1993

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm, @ V_C=2.5V (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (B=±50ppm, C=±100ppm), Frequency, Date Code

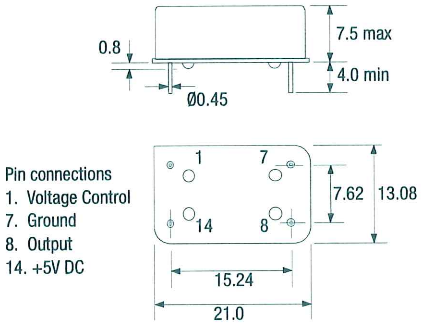
Output Frequency Change

- ±200ppm min

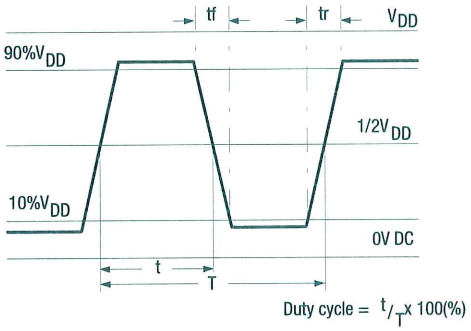
Voltage Control Pin 1

- 2.5V ±2.0V

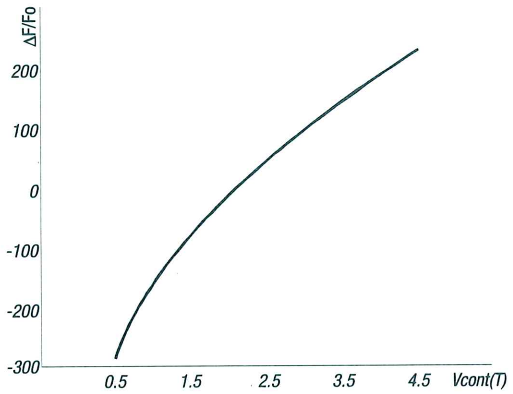
Outline



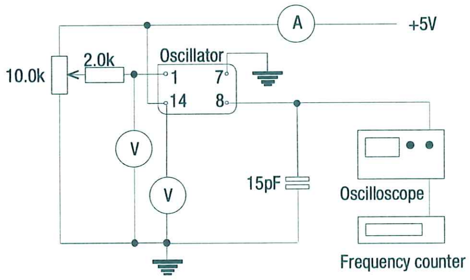
Output Waveform



Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±50ppm, ±100ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-174

IQVCXO-178

ISSUE 2; 21 MARCH 1993

Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm @ V_C=2.5V
  (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (A=±25ppm), Frequency, Date Code

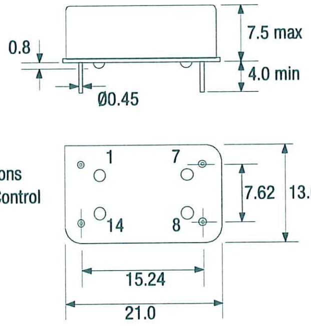
Output Frequency Change

- ±50ppm min

Voltage Control Pin 1

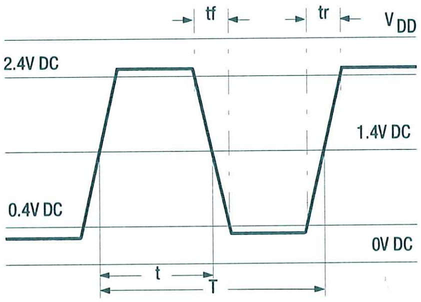
- 2.5V ±2.0V

Outline



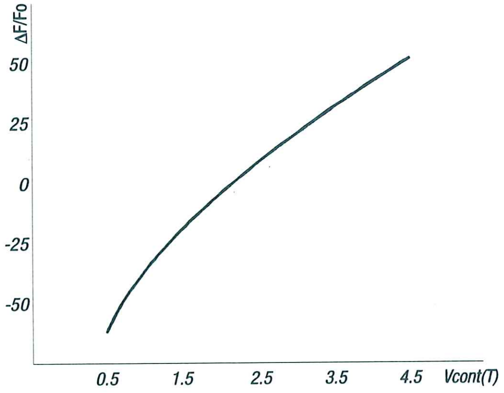
Pin connections
1. Voltage Control
7. Ground
8. Output
14. +5V DC

Output Waveform

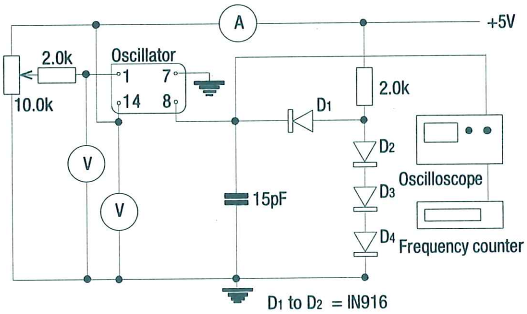


Duty cycle = t / T x 100(%)

Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



D_1 to D_2 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±25ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-178

IQVCXO-179

ISSUE 2; 21 MARCH 1993

Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±25ppm, ±50ppm, @ V_C=2.5V (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm), Frequency, Date Code

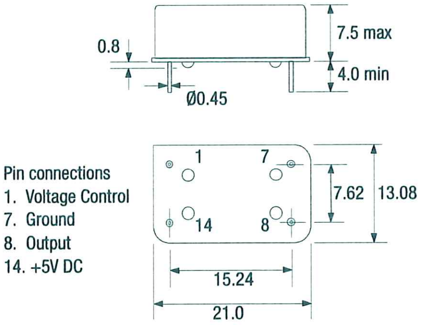
Output Frequency Change

- ±100ppm min

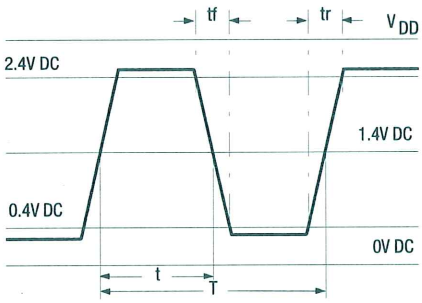
Voltage Control Pin 1

- 2.5V ±2.0V

Outline

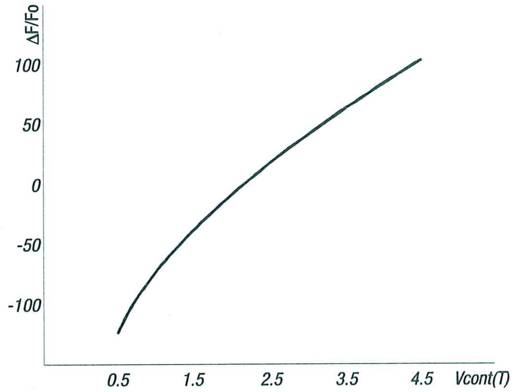


Output Waveform

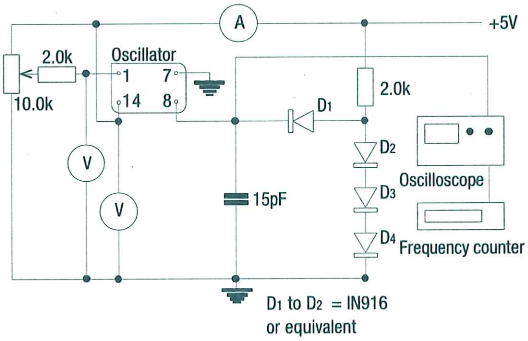


Duty cycle = t / T x 100(%)

Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±25ppm, ±50ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-179

IQVCXO-180

ISSUE 2; 21 MARCH 1994

Output Compatibility

- 10std LS TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure, hermetically sealed with glass to metal seals.

Standard Frequency Stabilities

- ±50ppm, ±100ppm, @ V_C=2.5V (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –30 to 85°C

Marking

- Printed on oscillator surface, includes Type Number with letter code identifying frequency stability (B=±50ppm, C=±100ppm), Frequency, Date Code

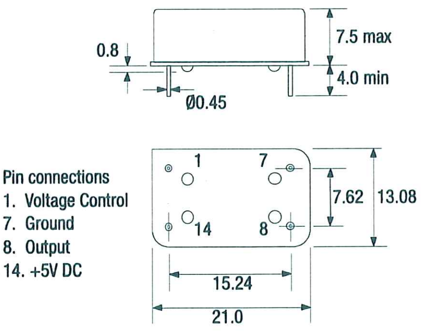
Output Frequency Change

- ±200ppm min

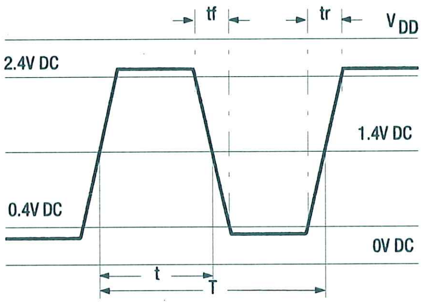
Voltage Control Pin 1

- 2.5V ±2.0V

Outline

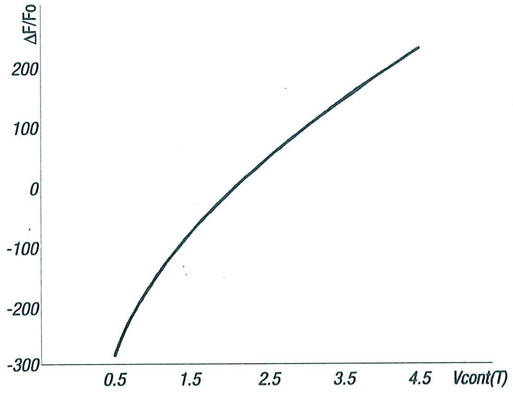


Output Waveform

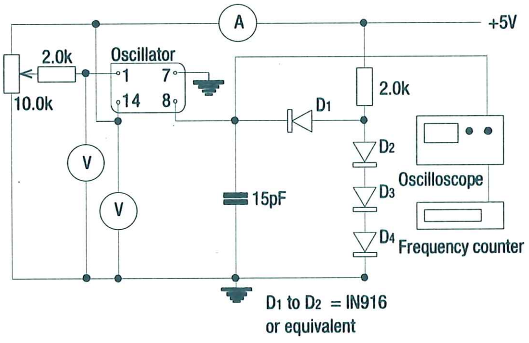


Duty cycle = t / T x 100(%)

Typical Voltage Control Curve @ 25°C & 20MHz



Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 24.0MHz	±50ppm, ±100ppm	5V±0.1V	15mA	10nS	10nS	40/60%	IQVCXO-180

PROGRAMMABLE OSCILLATORS - Section Contents

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IQEXO-3. 180

STOCK PROGRAMMABLE OSCILLATORS

8-pin DIL Clock Oscillators

Frequency	Type	Frequency Stability	Model No.	Stock No.
500.0kHz	TTL	±50ppm	IQXO-4	U422A
600.0kHz	TTL	±50ppm	IQXO-4	U420A
750.0kHz	TTL	±50ppm	IQXO-4	U401A
768.0kHz	TTL	±50ppm	IQXO-4	U403A
800kHz	TTL	±50ppm	IQXO-4	U405A
1.0MHz	TTL	±50ppm	IQXO-4	U409A
1.0MHz	TTL	±50ppm	IQXO-4P2	U409C
1048.576kHz	TTL	±50ppm	IQXO-4	U413A
1200.0kHz	TTL	±50ppm	IQXO-4	U415A
1228.80kHz	TTL	±50ppm	IQXO-4	U417A
1250.0kHz	TTL	±50ppm	IQXO-4	U419A
1250.0kHz	TTL	±50ppm	IQXO-4P2	U419C
1500.0kHz	TTL	±50ppm	IQXO-4	U421A

RTC Series

Frequency	Type	Frequency Stability	Model No.	Stock No.
32.7680kHz	RTC	±50ppm	IQ58321A	S580A

IQPXO Series

Frequency	Type	Frequency Stability	Model No.	Stock No.
600.0kHz	8640AN	±100ppm	IQPXO-600	S600A
768.0kHz	8640CN	±100ppm	IQPXO-768	S601A
1.0MHz	8640BN	±100ppm	IQPXO-1000	S602A

IQEXO Series

Frequency	Type	Frequency Stability	Model No.	Stock No.
12.0MHz	PXO	±100ppm	IQEXO-3C	X701A
12.2880MHz	PXO	±100ppm	IQEXO-3C	X702A
12.80MHz	PXO	±100ppm	IQEXO-3C	X712A
14.31818MHz	PXO	±100ppm	IQEXO-3C	X711A
14.74560MHz	PXO	±100ppm	IQEXO-3C	X703A
16.0MHz	PXO	±100ppm	IQEXO-3C	X704A
16.3840MHz	PXO	±100ppm	IQEXO-3C	X705A
17.73447MHz	PXO	±100ppm	IQEXO-3C	X706A
18.4320MHz	PXO	±100ppm	IQEXO-3C	X707A
19.66080MHz	PXO	±100ppm	IQEXO-3C	X708A
20.0MHz	PXO	±100ppm	IQEXO-3C	X709A
24.0MHz	PXO	±100ppm	IQEXO-3C	X710A

PROGRAMMABLE OSCILLATORS - Delivery Options

Programmable Oscillators - 8-pin DIL

Fundamental Frequency	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
÷2 pin 8 4.0 to 12.0MHz	±25, ±50 & ±100ppm	0 to 60°C	IQXO-4	3 days to 12 weeks	178
÷4 pin 7 2.0 to 6.0MHz					
÷8 pin 5 1.0 to 3.0MHz					
÷16 pin 6 500.0kHz to 1.5MHz					
12.0 to 25MHz	±100ppm	−10 to 70°C	IQEXO-3	8 to 10 weeks	180

Programmable Oscillators - 16-pin DIL

Fundamental Frequency	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
32.7680kHz	±5ppm	−10 to 60°C	IQPXO-8651E	8 to 10 weeks	Available on request
32.7680kHz	±50ppm	−10 to 70°C	IQPXO-8650E		
60.0kHz		−10 to 60°C	IQPXO-8651A		
60.0kHz		−10 to 70°C	IQPXO-8650A		
96.0kHz			IQPXO-8650C		
100.0kHz		−10 to 60°C	IQPXO-8651B		
100.0kHz		−10 to 70°C	IQPXO-8650B		
153.60kHz			IQPXO-8650D		
600.0kHz	±100ppm		IQPXO-8640AN		
768.0kHz			IQPXO-8640CN		
1.0MHz			IQPXO-8640BN		

IQXO-4 & IQXO-4P2

ISSUE 1; 24 SEPTEMBER 1992

Output Compatibility

- Standard TTL

Holder Style

- 8-pin DIL compatible glass filled nylon case, hermetically sealed by resin encapsulation

Standard Frequency Stabilities

- ±25ppm, ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 60°C

Standard Storage Temperature Range

- 0 to 60°C

Marking

- Includes Type Number with letter code identifying frequency stability (A=±25ppm, B=±50ppm, C=±100ppm), Frequency, Date Code

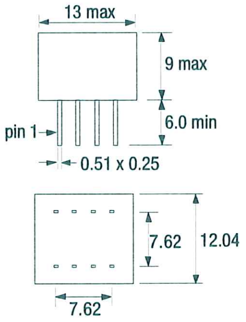
Enable/Disable Operation

- Logic '1' to pin 3 disables oscillator output
- Logic '0' to pin 3 enables oscillator output
- Normal operation requires pin 3 to be grounded

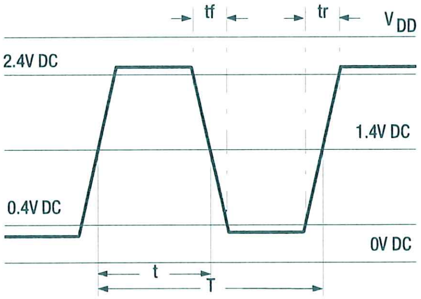
Ordering Information

- When ordering an IQXO-4 oscillator, the lowest frequency output must be specified.
- If an output is required on pin 2, please specify an IQXO-4P2 along with the lowest frequency required and pin 2 will then be the lowest frequency x16

Outline

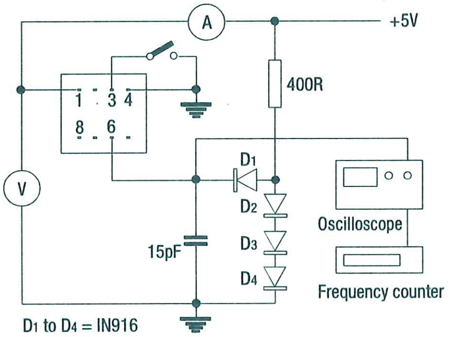


Output Waveform



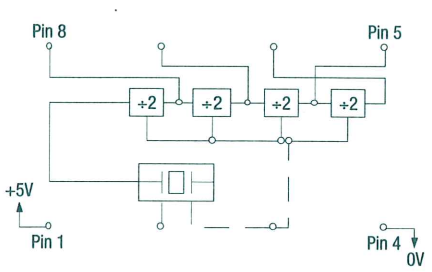
Duty cycle = t / T x 100(%)

Test Circuit

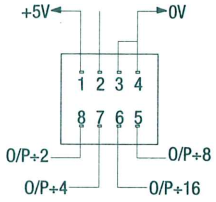


D1 to D4 = IN916
or equivalent

Pin Connections



Method of Connection



Note: The individual output frequency can be made available on Pin 2 by ordering IQXO-4P2

Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
÷2 pin 8 4.0 to 12.0MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	10std TTL	15nS	15nS	40/60%	IQXO-4
÷4 pin 7 2.0 to 6.0MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	10std TTL	15nS	15nS	40/60%	IQXO-4
÷8 pin 5 1.0 to 3.0MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	10std TTL	15nS	15nS	40/60%	IQXO-4
÷16 pin 6 500.0kHz to 1.5MHz	±25, ±50 & ±100ppm	5V±0.5V	60mA	10std TTL	15nS	15nS	40/60%	IQXO-4

IQEXO-3

ISSUE 1; 11 FEBRUARY 1992

Output Compatibility

- HCMOS

Holder Style

- 8-pin DIL compatible plastic encapsulated

Standard Frequency Stabilities

- ±100ppm

Standard Operating Temperature Range

- –10 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

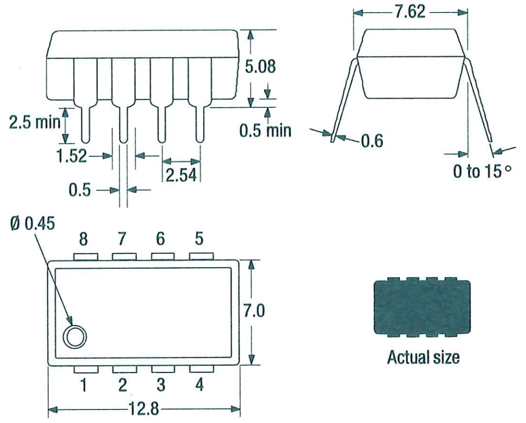
Mechanical Specification

- Mechanical Shock: 1000G, ½ sine wave impulse for 0.35mS in three directions
- Resistance to Soldering Heat: Leads dipped in soldering bath @ 260°C for 10 secs
- Resistance to Solvent: Dipping in fluoric solvent for 90 secs
- Solderability: ;90% of soldered surface masked with new solder after dipping in solder bath @230°C for 3 secs
- Vibration: 10 to 55Hz 1.5mm displacement, 50 to 2000Hz 20G acceleration, 1 hour in each of three mutually perpendicular planes

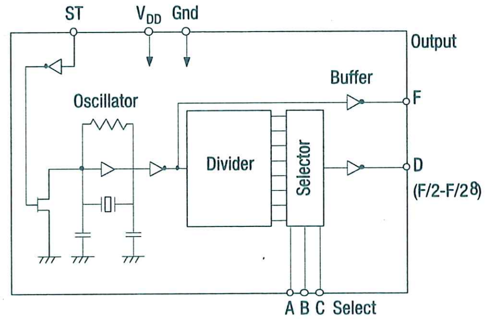
Handling & Operational Precautions

- Observe anti-static handling precautions
- A decoupling capacitor of <0.01µf should be connected between Pin 8 and Ground

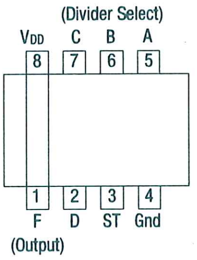
Outline (scale 2:1)



Circuit Diagram



Terminal Connections



Electrical Specification – Maximum Limiting Values

Supply Voltage	Input Voltage		Output Voltage		Rise Time (t_r)	Fall Time (t_f)	Current		Start-up Time		Duty Cycle	Aging
	High	Low	High	Low			Supply	Standby	Supply	Standby		
5.0V±1V	3.6V min	0.8V max	4.5V min	0.5V max	15nS max	15ns max	20mA	10.0µA	1.5mS	1.5mS	40 to 60%	±5ppm

Terminal Connections

- 1: Fundamental frequency output (fo)
- 2: Divided frequency output (fo/2^n)
- 3: Standby terminal; Logic '1' to pin 3 enables oscillator output; logic '0' to pin 3 disables oscillator output; when disabled the oscillator output goes to the high impedance state
- 4: Ground
- 5: Programs dividing ratio for fundamental oscillation
- 6: Programs dividing ratio for fundamental oscillation
- 7: Programs dividing ratio for fundamental oscillation
- 8: Power supply voltage

Frequency Programming

Input				Output	
Select			Pin 3	Pin 1 Fundamental Oscilation	Pin 2 Dividing Frequency
Pin 7	Pin 6	Pin 5			
L	L	L	H	fo clock	fo ½ clock
L	L	H	H	fo clock	fo $1/2^2$ clock
L	H	L	H	fo clock	fo $1/2^3$ clock
L	H	H	H	fo clock	fo $1/2^4$ clock
H	L	L	H	fo clock	fo $1/2^5$ clock
H	L	H	H	fo clock	fo $1/2^6$ clock
H	H	L	H	fo clock	fo $1/2^7$ clock
H	H	H	H	fo clock	fo $1/2^8$ clock

Standard Frequency (MHz)

Fundamental Frequency (fo)	Dividing Frequency (fo/2^n)							
$1/2^0$ MHz	$1/2^1$ MHz	$1/2^2$ MHz	$1/2^3$ MHz	$1/2^4$ kHz	$1/2^5$ kHz	$1/2^6$ kHz	$1/2^7$ kHz	$1/2^8$ kHz
12.0	6.0	3.0	1.50	750.0	375.0	187.50	93.750	46.8750
12.2880	6.1440	3.0720	1.5360	768.0	384.0	192.0	96.0	48.0
12.80	6.40	3.20	1.60	800.0	400.0	200.0	100.0	50.0
14.318180	7.159090	3.579545	1.789772	894.880	447.440	223.720	111.860	55.930
14.50	7.250	3.6250	1.81250	906.250	453.1250	226.5620	113.2810	56.640
14.74560	7.37280	3.68640	1.84320	921.60	460.80	230.40	115.20	57.60
14.91050	7.45520	3.72760	1.86380	931.9060	465.9530	232.9760	116.4880	58.2440
15.0	7.50	3.750	1.8750	937.50	468.750	234.3750	117.1870	58.5930
15.360	7.680	3.840	1.920	960.0	480.0	240.0	120.0	60.0
15.97440	7.98720	3.99360	1.99680	998.40	499.20	249.60	124.80	62.40
16.0	8.0	4.0	2.0	1000.0	500.0	250.0	125.0	62.50
16.1280	8.0640	4.0320	2.0160	1008.0	504.0	252.0	126.0	63.0
16.2570	8.125850	4.06425	2.032125	1016.0620	508.030	254.0150	127.0070	63.5030
16.3840	8.1920	4.0960	2.0480	1024.0	512.0	256.0	128.0	64.0
17.734476	8.867238	4.433619	2.216809	1108.4	554.20	277.10	138.550	69.2750
18.4320	9.2160	4.6080	2.3040	1152.0	576.0	288.0	144.0	72.0
19.09090	9.545450	4.772725	2.386362	1193.1810	596.590	298.2950	149.1470	74.5730
19.20	9.60	4.80	2.40	1200.0	600.0	300.0	150.0	75.0
19.66080	9.83040	4.91520	2.45760	1228.80	614.40	307.20	153.60	76.80
20.0	10.0	5.0	2.5	1250.0	625.0	312.50	156.250	78.1250
20.480	10.240	5.120	2.560	1280.0	640.0	320.0	160.0	80.0
21.477270	10.738635	5.369317	2.684650	1342.3290	671.1640	355.5820	167.7910	83.89550
22.0	11.0	5.50	2.750	1375.0	687.50	343.750	171.8750	85.93750
22.11840	11.05920	5.52960	2.76480	1382.40	691.20	345.60	172.80	86.40
24.0	12.0	6.0	3.0	1500.0	750.0	375.0	187.50	93.750
24.5760	12.2880	6.1440	3.0720	1536.0	768.0	384.0	192.0	96.0

TCXOs - Section Contents

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TCXOs - Delivery Options

HCMOS Temperature Compensated Crystal Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model Number	Delivery Options	Full Specification Page
1.0 to 120.0MHz	±1ppm, ±2ppm	0 to 50°C	IQTCXO-183	6 to 12 weeks	186
		0 to 70°C	IQTCXO-184		
	±2ppm	–20 to 70°C	IQTCXO-185		
	±3ppm	–30 to 75°C	IQTCXO-186		
	±5ppm, ±10ppm	–55 to 105°C	IQTCXO-187		
7.2 to 25.0MHz	±2.5ppm	–30 to 75°C	IQTCXO-136	3 to 12 weeks	185

TTL Temperature Compensated Crystal Oscillators - 14-pin DIL

Frequency Range	Frequency Stability	Operating Temperature Range	Model Number	Delivery Options	Full Specification Page
1.0 to 110.0MHz	±1ppm, ±2ppm	0 to 50°C	IQTCXO-190	6 to 12 weeks	188
		0 to 70°C	IQTCXO-191		
	±2ppm	–20 to 70°C	IQTCXO-192		
	±3ppm	–30 to 75°C	IQTCXO-193		
	±5ppm, ±10ppm	–55 to 105°C	IQTCXO-194		

TTL Temperature Compensated Crystal Oscillators - 26 x26 x 12.7 package

Frequency Range	Frequency Stability	Operating Temperature Range	Model Number	Delivery Options	Full Specification Page
10.0kHz to 110.0MHz	±0.25, ±0.5ppm	0 to 50°C	IQTCXO-212	6 to 12 weeks	192
	±0.5, ±1, ±2ppm	0 to 70°C	IQTCXO-213		
		–20 to 70°C	IQTCXO-214		
		–30 to 75°C	IQTCXO-215		
		–40 to 85°C	IQTCXO-216		
	±2.5, ±5, ±10ppm	–55 to 105°C	IQTCXO-217		

TTL Temperature Compensated Crystal Oscillators - 39 x39 x 12.7 package

Frequency Range	Frequency Stability	Operating Temperature Range	Model Number	Delivery Options	Full Specification Page
10.0kHz to 110.0MHz	±0.25, ±0.5ppm	0 to 50°C	IQTCXO-204	6 to 12 weeks	190
	±0.5, ±1, ±2ppm	0 to 70°C	IQTCXO-205		
		–20 to 70°C	IQTCXO-206		
		–30 to 75°C	IQTCXO-207		
		–40 to 85°C	IQTCXO-208		
	±2.5, ±5, ±10ppm	–55 to 105°C	IQTCXO-209		

IQTCXO-136

ISSUE 4; 22 MARCH 1994

Description

- IQTCXO-136 are temperature compensated crystal oscillators providing a high degree of frequency stability over a wide temperature range. They are particularly suited to applications where space is at a premium

Holder Style

- 14-pin DIL compatible solder sealed enclosure with internal trimmer

Standard Frequency Stabilities

- ±2.5ppm
(inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Ranges

- –30 to 75°C

Aging

- ±1ppm typical for each year of use

Frequency Adjustment

- ±3ppm minimum mechanical trimmer adjustment sufficient to compensate for 5 years aging

Waveform

- Clipped Sine 1V peak to peak

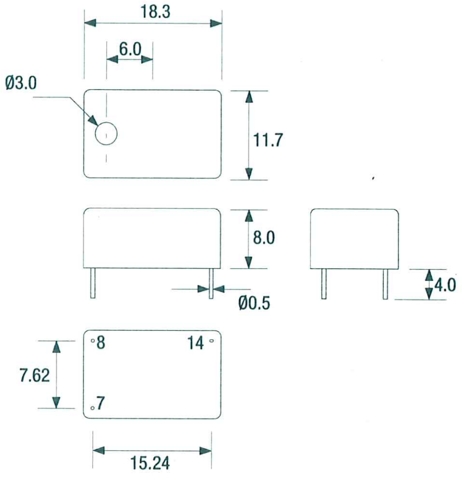
Standard Storage Temperature Range

- –55 to 105°C

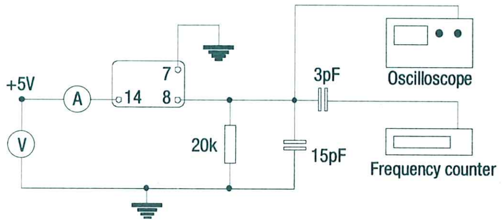
Marking

- Includes Type Number, with letter code identifying Frequency Stability (H=±2.5ppm), Frequency, Date Code

Outline



Test Circuit



Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Stability	Operating Temperature Range	Supply Voltage	Supply Current	Output Load	Duty Cycle	Model Number
7.2 to 25.0MHz	±2.5ppm	–30 to 75°C	5V±0.5V	3mA	20kΩ/5pf	40/60%	IQTCXO-136

IQTCXO-183, -184, -185, -186, -187

ISSUE 2; 22 MARCH 1994

Description

- IQTCXO models -183 to -187 are temperature compensated crystal oscillators providing a high degree of frequency stability over a wide temperature range. They are particularly suited to applications where space is at a premium

Output Compatibility

- 10std HCMOS

Holder Style

- 14-pin DIL compatible resistance welded enclosure with glass to metal seals

Standard Frequency Stabilities

- ±1ppm, ±2ppm, ±3ppm, ±5ppm, ±10ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Ranges

- 0 to 50°C
  0 to 70°C
  –20 to 70°C
  –30 to 75°C
  –55 to 105°C

Aging

- ±2ppm typical first year followed by ±1ppm typical for each subsequent year

Optional Frequency Adjustment

- ±5ppm minimum by applying 0.5V to 4.5V on pin 1

Standard Storage Temperature Range

- –55 to 125°C

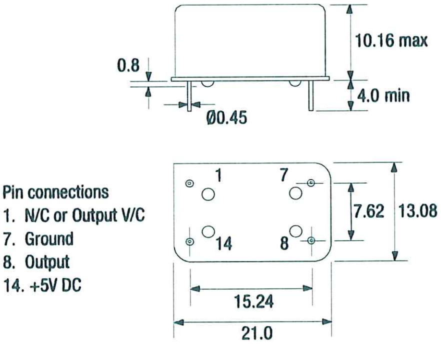
Marking

- Includes Type Number, with letter code identifying Frequency Stability (F=±1ppm, G=±2ppm, J=±3ppm, K=±5ppm, L=±10ppm), Frequency, Date Code

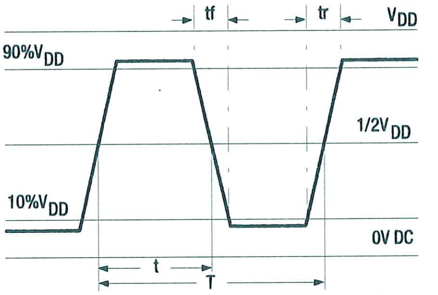
Environmental Specification

- Various screening options available

Outline

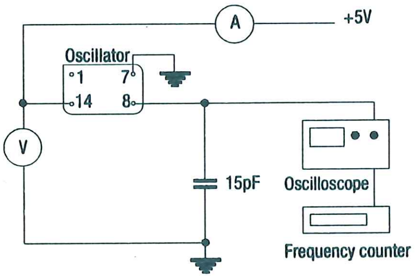


Output Waveform



Duty cycle = t/T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Operating Temperature Range	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 120.0MHz	±1ppm, ±2ppm	0 to 50°C	5V±0.5V	40mA	15nS	15nS	40/60%	IQTCXO-183
1.0 to 120.0MHz	±1ppm, ±2ppm	0 to 70°C	5V±0.5V	40mA	15nS	15nS	40/60%	IQTCXO-184
1.0 to 120.0MHz	±2ppm	–20 to 70°C	5V±0.5V	40mA	15nS	15nS	40/60%	IQTCXO-185
1.0 to 120.0MHz	±3ppm	–30 to 75°C	5V±0.5V	40mA	15nS	15nS	40/60%	IQTCXO-186
1.0 to 120.0MHz	±5ppm, ±10ppm	–55 to 105°C	5V±0.5V	40mA	15nS	15nS	40/60%	IQTCXO-187

Note: The supply current will reduce as the frequency is reduced; for presise values of current consumption please contact the sales office

IQTCXO-190, -191, -192, -193, -194

ISSUE 2; 22 MARCH 1994

Description

- IQTCXO models -190 to -194 are temperature compensated crystal oscillators providing a high degree of frequency stability over a wide temperature range. They are particularly suited to applications where space is at a premium

Output Compatibility

- 10std TTL

Holder Style

- 14-pin DIL compatible resistance welded enclosure with glass to metal seals

Standard Frequency Stabilities

- ±1ppm, ±2ppm, ±3ppm, ±5ppm, ±10ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Ranges

- 0 to 50°C
  0 to 70°C
  –20 to 70°C
  –30 to 75°C
  –55 to 105°C

Aging

- ±2ppm typical first year followed by ±1ppm typical for each subsequent year

Optional Frequency Adjustment

- ±5ppm minimum by applying 0.5V to 4.5V on pin 1

Standard Storage Temperature Range

- –55 to 125°C

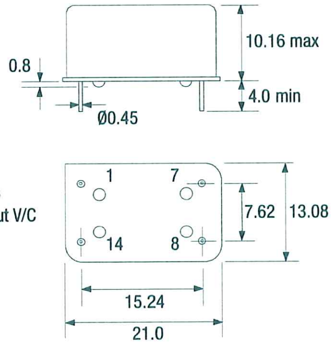
Marking

- Includes Type Number, with letter code identifying Frequency Stability (F=±1ppm, G=±2ppm, J=±3ppm, K=±5ppm, L=±10ppm), Frequency, Date Code

Environmental Specification

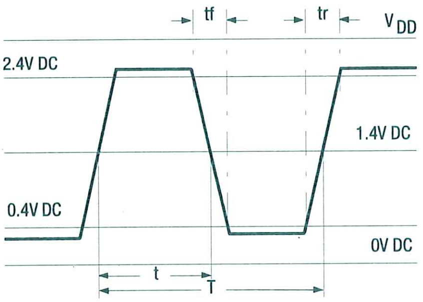
- Various screening options available

Outline



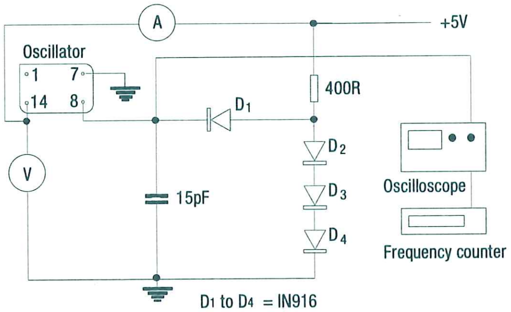
Pin connections
1. N/C or Output V/C
7. Ground
8. Output
14. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



D1 to D4 = IN916
or equivalent

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Operating Temperature Range	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 110.0MHz	±1ppm, ±2ppm	0 to 50°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-190
1.0 to 110.0MHz	±1ppm, ±2ppm	0 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-191
1.0 to 110.0MHz	±2ppm	–20 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-192
1.0 to 110.0MHz	±3ppm	–30 to 75°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-193
1.0 to 110.0MHz	±5ppm, ±10ppm	–55 to 105°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-194

Note: The supply current will reduce as the frequency is reduced; for presise values of current consumption please contact the sales office

IQTCXO-204, -205, -206, -207, -208, -209

ISSUE 2; 22 MARCH 1994

Description

- IQTCXO models -204 to -209 are temperature compensated crystal oscillators providing very high degrees of frequency stability over wide temperature ranges. They are particularly suited to the most exacting applications

Output Compatibility

- 10std TTL

Holder Style

- 39 x 39 x 12.7mm solder sealed enclosure with a frequency adjustment trimmer mounted on the side of the oscillator

Standard Frequency Stabilities

- ±0.25ppm, ±0.5ppm, ±1ppm, ±2ppm, ±2.5ppm, ±5ppm, ±10ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Ranges

- 0 to 50°C
  0 to 70°C
  –20 to 70°C
  –30 to 75°C
  –40 to 85°C
  –55 to 105°C

Aging

- ±1ppm typical for each year of use

Frequency Adjustment

- ±5ppm minimum mechanical trimmer adjustment sufficient to compensate for 5 years aging

Standard Storage Temperature Range

- –55 to 105°C

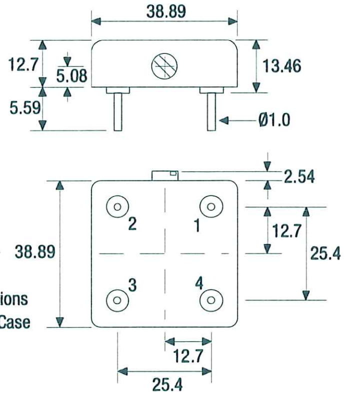
Marking

- Includes Type Number, with letter code identifying Frequency Stability (D=±0.25ppm, E=±0.5ppm, F=±1ppm, G=±2ppm, H= ±2.5ppm, K=±5ppm, L=±10ppm), Frequency, Date Code

Environmental Specification

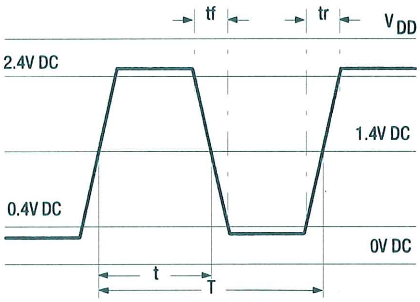
- Various screening options available

Outline (scale 1:2)



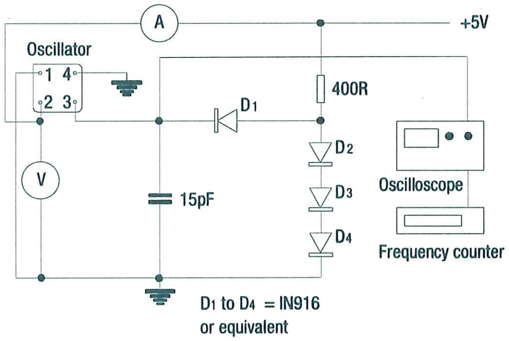
Pin connections
1. Ground, Case
2. Supply
3. Output
4. Ground

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Operating Temperature Range	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
10.0kHz to 110.0MHz	±0.25, ±0.5ppm	0 to 50°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-204
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	0 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-205
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–20 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-206
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–30 to 75°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-207
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–40 to 85°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-208
10.0kHz to 110.0MHz	±2.5, ±5, ±10ppm	–55 to 105°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-209

Note: The supply current will reduce as the frequency is reduced; for presise values of current consumption please contact the sales office

IQTCXO-212, -213, -214, -215, -216, -217

ISSUE 2; 22 MARCH 1994

Description

- IQTCXO models -212 to -217 are temperature compensated crystal oscillators providing very high degrees of frequency stability over wide temperature ranges. They are particularly suited to the most exacting applications

Output Compatibility

- 10std TTL

Holder Style

- 26 x 26 x 12.7mm solder sealed enclosure with a frequency adjustment trimmer mounted on the side of the oscillator

Standard Frequency Stabilities

- ±0.25ppm, ±0.5ppm, ±1ppm, ±2ppm, ±2.5ppm, ±5ppm, ±10ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Ranges

- 0 to 50°C
  0 to 70°C
  –20 to 70°C
  –30 to 75°C
  –40 to 85°C
  –55 to 105°C

Aging

- ±1ppm typical for each year of use

Frequency Adjustment

- ±5ppm minimum mechanical trimmer adjustment sufficient to compensate for 5 years aging

Standard Storage Temperature Range

- –55 to 105°C

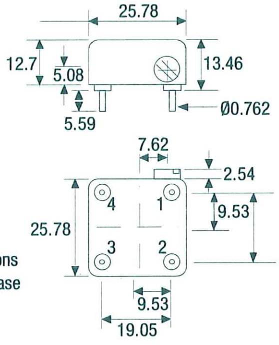
Marking

- Includes Type Number, with letter code identifying Frequency Stability (D=±0.25ppm, E=±0.5ppm, F=±1ppm, G=±2ppm, H= ±2.5ppm, K=±5ppm, L=±10ppm), Frequency, Date Code

Environmental Specification

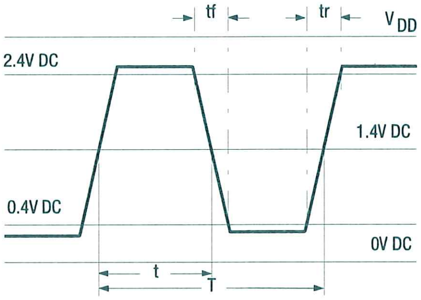
- Various screening options available

Outline (scale 1:2)



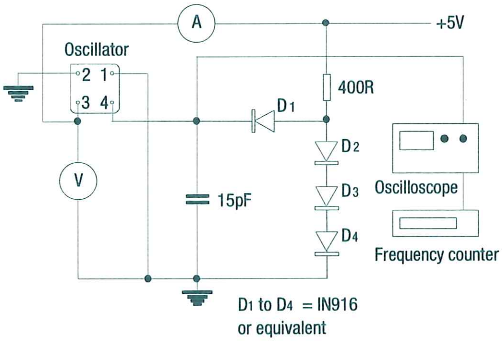
Pin connections
1. Ground, Case
2. Ground
3. Supply
4. Output

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Operating Temperature Range	Supply Voltage	Supply Current	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
10.0kHz to 110.0MHz	±0.25, ±0.5ppm	0 to 50°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-212
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	0 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-213
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–20 to 70°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-214
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–30 to 75°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-215
10.0kHz to 110.0MHz	±0.5, ±1, ±2ppm	–40 to 85°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-216
10.0kHz to 110.0MHz	±2.5, ±5, ±10ppm	–55 to 105°C	5V±0.5V	45mA	10nS	10nS	40/60%	IQTCXO-217

Note: The supply current will reduce as the frequency is reduced; for presise values of current consumption please contact the sales office

LC & CRYSTAL FILTERS - Section Contents

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STANDARD FILTERS

MONOLITHIC FILTERS

Model	Centre Frequency	Passband Width		Attenuation Bandwidth				Ripple (max)	Ins. Loss (max)	Terminating Impedance (ΩS/Pf)	Holder
IQXF-9M20A	9.0MHz	±10.0kHz	3dB	±30.0kHz	20dB			1.0dB	3dB	5k	HC49/T
IQXF-9M22C	9.0MHz	±1.1kHz	6dB	±1.55kHz	20dB	±3.0kHz	60dB	2.0dB	4dB	700/18	15x12x15mm
IQXF-10M22C	10.7MHz	±1.1kHz	6dB	±1.55kHz	20dB	±3.0kHz	60dB	2.0dB	4dB	500/18	15x12x15mm
IQXF-10M08A	10.7MHz	±3.75kHz	3dB	±12.5kHz	18dB			0.5dB	2.0dB	1.5k/5	HC49/T
IQXF-10M08C	10.7MHz	±3.75kHz	6dB	±8.75kHz	45dB	±12.5kHz	60dB	2.0dB	3.0dB	1.5k/1	15x12x15mm
IQXF-10M15A	10.7MHz	±7.5kHz	3dB	±25.0kHz	18dB			0.5dB	2.0dB	3k/2	HC49/T
IQXF-10M15C	10.7MHz	±7.5kHz	6dB	±23.0kHz	60dB			2.0dB	3.0dB	3k/1	15x12x15mm
IQXF-10M15D	10.7MHz	±7.5kHz	6dB	±15.0kHz	60dB	±20kHz	80dB	2.0dB	4.0dB	3k/1	18x12x15mm
IQXF-10M20A	10.7MHz	±10.0kHz	3dB	±33.0kHz	18dB			0.5dB	2.0dB	3.9k	HC49/T
IQXF-10M30A	10.7MHz	±15.0kHz	3dB	±50.0kHz	18dB			0.5dB	2.0dB	5k/-1.5	HC49/T
IQXF-21M15A	21.4MHz	±7.5kHz	3dB	±25.0kHz	20dB			0.5dB	2.0dB	1.6k/2	HC49/T
IQXF-21M7.5AU	21.4MHz	±3.75kHz	3dB	±15.0kHz	20dB			0.5dB	2.0dB	900/5	UM1
IQXF-21M15AU	21.4MHz	±7.5kHz	3dB	±30.0kHz	20dB			0.5dB	2.0dB	1.5k/5	UM1
IQXF-45M15AU	45.0MHz	±7.5kHz	3dB	±25.0kHz	18dB			1.0dB	3.0dB	3k	UM1

DISCRETE CRYSTAL FILTERS

Model	Centre Frequency	Mode	6dB Passband (min)	60dB Stopband (min)	Insertion Loss (max)	Ult Attenuation (min)	Terminating Impedance (ΩS/Pf)	Holder
IQXF-33H250	3.395MHz	CW	250Hz	750Hz	9dB	80dB	4.7k/33	50x25x25mm
IQXF-88H250	8.8307MHz	CW	250Hz	750Hz	10dB	80dB	470/5	50x18x18mm
IQXF-89H250	8.9883MHz	CW	250Hz	750Hz	10dB	80dB	500/-	40x20x21mm
IQXF-91H250	8.9993MHz	CW	250Hz	750Hz	10dB	80dB	500/-	40x20x21mm
IQXF-90F0.5B	9.0MHz	CW	500Hz	2200Hz	5dB	90dB	500/30	40x20x21mm
IQXF-90H2.4B	9.0MHz	SSB	2.4kHz	4.3kHz	3.5dB	100dB	500/30	40x20x21mm
IQXF-90H12B	9.0MHz	FM	12.0kHz	21.6kHz	3.5dB	90dB	12000/30	36x22x19mm
IQXF-107H15A	10.7MHz	FM	15.0kHz	35.0kHz	3.5dB	90dB	910/25	40x20x20mm
IQXF-21H15A	21.4MHz	FM	15.0kHz	50.0kHz	3.5dB	80dB	910/25	20x12x15mm

CRYSTAL & LC FILTERS - MADE-TO-ORDER

IQD manufacturers application-specific (custom) crystal and LC filters and discriminators for commercial and military communications and instrumentation applications. We offer an extensive line of cost-effective filters and discriminators, plus the design and manufacturing capability to develop new products to meet your unique design objectives.

IQD's major emphasis is on application specific (custom) crystal and LC filter & discriminator applications. Our general capabilities are:

a) crystal filters in all polynomials and package configurations from 50 KHz to 115 MHz with fractional bandwidths of 0.002% to 3%.

b) LC filters in all polynomials and package configurations from 10 KHz to 500 MHz with fractional bandwidths of 3% to 100%.

c) crystal discriminators in all package configurations from 3.0 MHz to 80 MHz with up to 1% peak to peak bandwidths, distortion to less than 1% and video bandwidths up to 50 KHz.

IQD offers complete capability for the production of our filter and discriminator products. This capability benefits our customers as follows:

a) An engineering team that is experienced in developing the most cost-effective solution for our customers' application.

b) Strict in-house control of design procedures, material selection, manufacturing processes and test procedures provide our customers with products of the highest quality and reliability.

c) In-house manufacture of crystals provides precise control of these critical components for our filters and discriminators.

d) Our total capability enables us to reduce response and delivery times for our customers' prototype or production needs.

e) Our quality assurance procedures meet or exceed the requirements of BS5750.

HOW TO ORDER CRYSTAL FILTERS

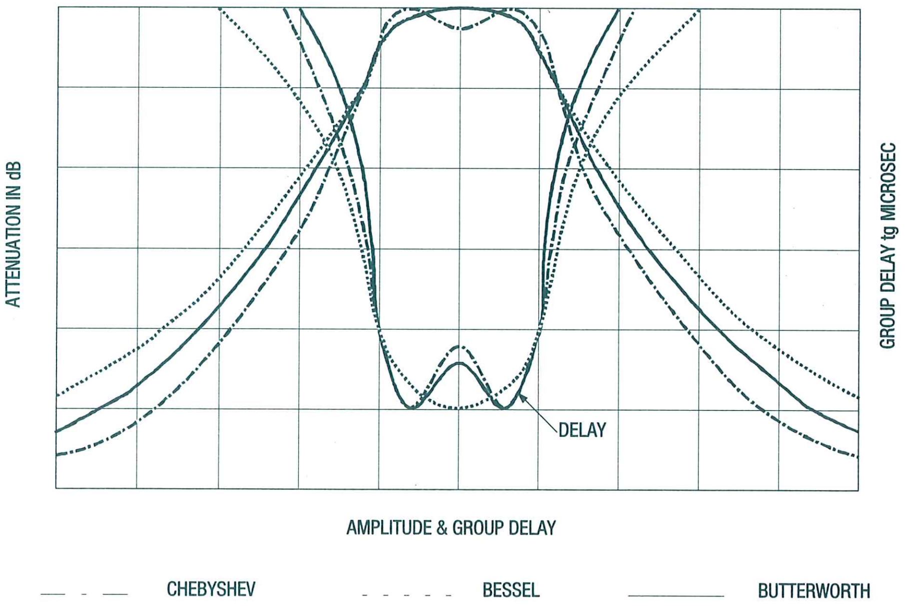
Definitions

The following terms and definitions will aid you in specifying a filter for your application.

Minimum Order Information for Bandpass Filters

- Centre Frequency + Passband + Stopband + Ripple

Delay Graph



Passband

- Insertion Loss: The loss at centre frequency, normally expressed in dB, resulting from the insertion of a device in a transmission system.
- Flat Loss: The insertion loss at the frequency of minimum loss within the passband.
- Attenuation: the loss of a filter at a given frequency measured in dB.
- Passband (BW): The range of frequencies attenuated less than a specified value, typically 3 or 6 dB.
- Centre Frequency (Fo): The arithmetic mean of the passband limits.
- Fractional Bandwidth: A specified frequency, typically the minimum loss point or Fo, from which all attenuation measurements are made.
- Ripple: The amplitude difference, in dB, between the maximum passband peak and minimum passband valley. Both the peak and the valley are defined by a surrounding change in slope, i.e. sign of the amplitude response.

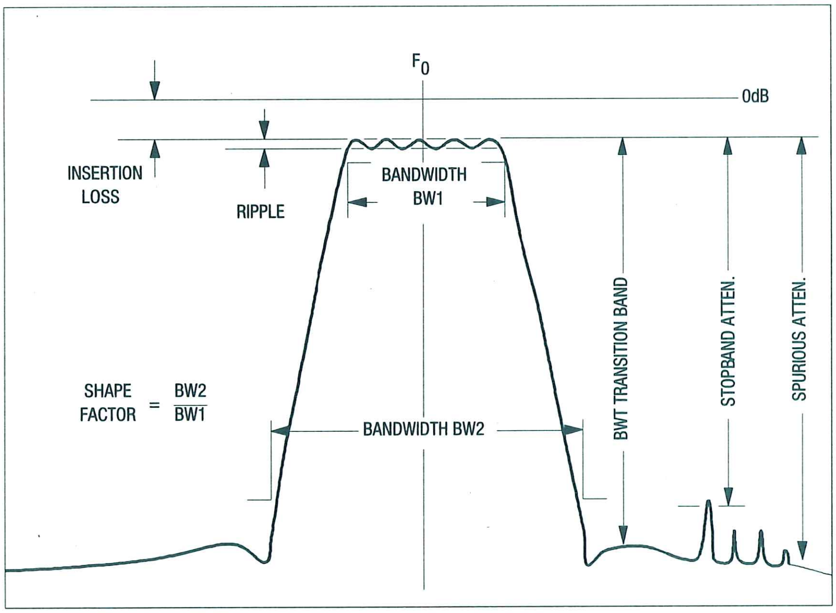
Stopband

- Attenuation: The output of a filter at a given frequency relative to the defined insertion loss reference.
- Stopband: The range of frequencies attenuated greater than some specified minimum level of attenuation.
- Transition Band (BW): The range of frequencies differently attenuated between the passband and stopband limits.
- Shape Factor: The ratio of the bandwidth at some point within the transition region, typically 60 dB, to the specified passband bandwidth.
- Spurious Attenuation: The specified minimum level of attenuation received by all non-harmonic related resonances of each crystal resonator with the filter network.

Time Domain

- Insertion Phase: The phase shift at the output load (measured at the reference frequency) resulting from insertion of the filter.
- Differential Phase: The measurement of phase at a given frequency relative to the phase at the reference frequency.
- Phase Linearity: The phase error in degrees between the phase points and the best straight line drawn through the phase points.
- Group Delay: The time by which an input signal will be delayed before it appears at the filter output, i.e. the derivative of phase with respect to frequency.
- Differential Delay: The measurement of delay at a given frequency relative to the reference frequency.

Filter Characteristics



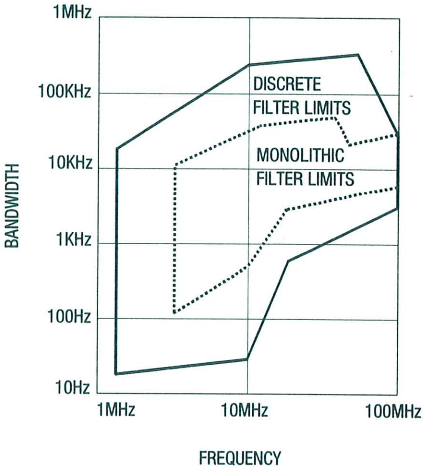
Source & Load Impedance

- Source Impedance: The impedance of the circuit driving the filter, measured at the reference frequency.
- Load Impedance: The impedance of the circuit terminating the filter, at its output measured at the reference frequency.

Non-Linear Effect

- Maximum Level: The driving point power, voltage or current level above which intolerable signal distortion or damage to the device will result.
- Drive Level Stability: The ability of the crystal filter to return within a specified tolerance of its original insertion loss, at a specified drive level, after experiencing changing environmental and/or drive level conditions.
- Drive Level Linearity: The maximum permissible variation in insertion loss, per dB change in drive level, measured over a specified dynamic range.
- Inband Intermodulation Distortion: The attenuation, in dB, of 3rd and higher order signal products, inband, relative to the power level of two signals placed within the passband.
- Out of Band Intermodulation Distortion: The attenuation, in dB, of 3rd and higher order signal products, inband, relative to the power level of two signals placed in the stopband, or one tone in the transition region and the other in the stopband.

Frequency vs Bandwidth Limits



SM CERAMIC RESONATORS - Section Contents

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IQC-6 SM Ceramic Resonators with capacitor 3.58 to 8.0MHz 206

NOTES

SM CERAMIC RESONATORS - Delivery Options

SM Ceramic Resonators

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
3.58 to 12.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-5	6 to 12 weeks	204

SM Ceramic Resonators with Integral Capacitor

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
3.58 to 8.0MHz	±5000ppm (±0.5%)	±3000ppm (±0.3%)	–20 to 80°C	IQC-6	6 to 12 weeks	206

IQC-5 SM CERAMIC RESONATORS 2.0 to 8.0MHz

ISSUE 1; 8 JULY 1993

Holder Style

- Surface mount device (SMD) in ceramic case

General Specifications

- Load Capacitance (C_L): 33pf

Standard Frequency Tolerances and Stabilities

- ±3000ppm (0.3%), ±5000ppm (0.5%)

Standard Operating Temperature Ranges

- –20 to 80°C

Standard Storage Temperature Range

- –30 to 85°C

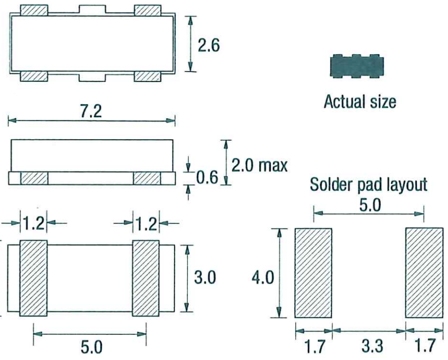
Packaging

- IQC-5 surface mount ceramic resonators are available packaged individually or on tape and reel, 2,000 pieces per reel with 10 positions open at begining and end of reel; leader will be 200mm maximum

Marking

- Printed on resonator surface, includes frequency and date code

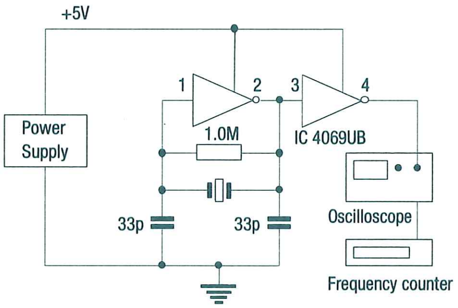
Outline (scale 3:1)



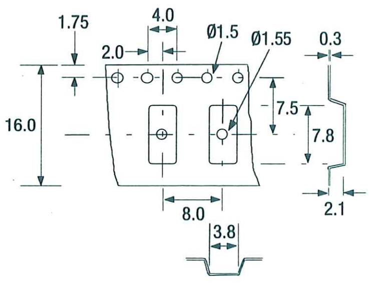
Solder pads indicated by shaded areas

Dimensions ±0.3

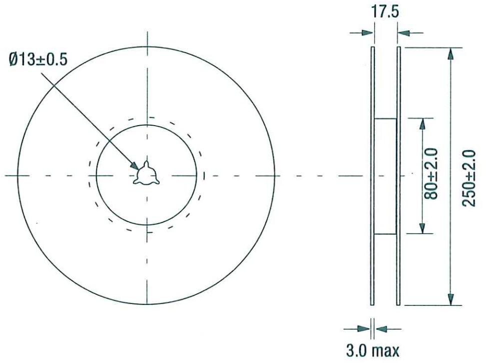
Test Circuit



Outline - Tape



Outline - Reel



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
2.0 to 8.0MHz	±5000ppm (0.5%)	±3000ppm (0.3%)	–20 to 80°C	30Ω	Fundamental

IQC-6 SM Ceramic Resonators with capacitor 2.0 to 20.0MHz

ISSUE 1; 31 AUGUST 1993

Holder Style

- Surface mount device (SMD) in ceramic case

General Specifications

- Load Capacitance (C_L):
  33pf (2.0 to 8.0MHz)
  10pf (8.1 to 20.0MHz)

Standard Frequency Tolerances and Stabilities

- ±3000ppm (0.3%), ±5000ppm (0.5%)(2.0 to 8.0MHz)
  ±1000ppm (0.1%), ±7000ppm (0.7%) (8.1 to 20.0MHz)

Standard Operating Temperature Ranges

- –20 to 80°C

Standard Storage Temperature Range

- –30 to 85°C

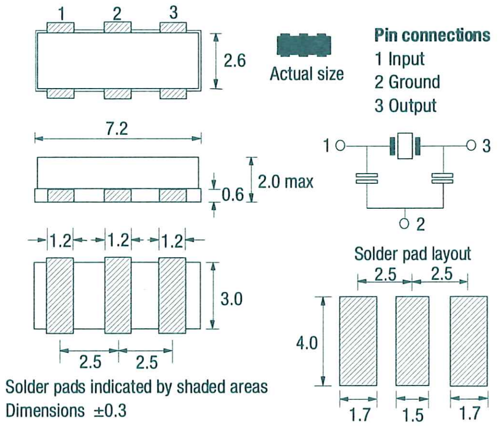
Packaging

- IQC-6 surface mount ceramic resonators are available packaged individually or on tape and reel, 2,000 pieces per reel with 10 positions open at begining and end of reel; leader will be 200mm maximum

Marking

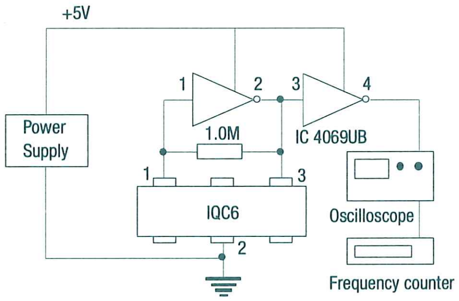
- Printed on resonator surface, includes frequency and date code

Outline (scale 3:1)



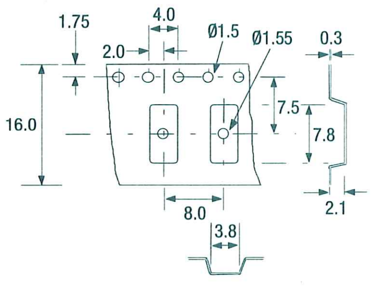
Solder pads indicated by shaded areas
Dimensions ±0.3

Test Circuit

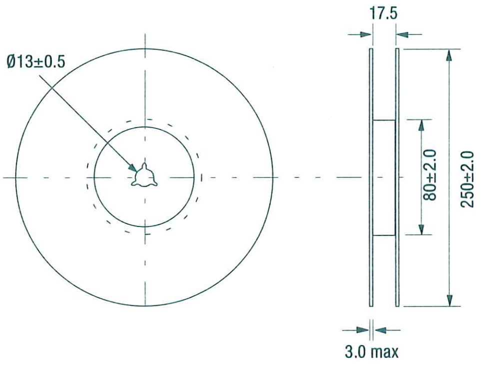


SM CERAMIC RESONATORS

Outline - Tape



Outline - Reel



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
2.0 to 8.0MHz	±5000ppm (0.5%)	±3000ppm (0.3%)	–20 to 80°C	30Ω	Fundamental
8.1 to 20.0MHz	±7000ppm (0.7%)	±1000ppm (0.1%)	–20 to 80°C	150Ω	Fundamental

SM QUARTZ CRYSTALS - Section Contents

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90SMX & 91SMX SM Crystals 20 to 200kHz. 212

86SMX SM Crystals 3.57 to 60MHz. 214

CX1V-T SM Crystals 10kHz to 2.0MHz. 216

CX1V-T SM Crystals 8 to 32MHz 218

12SMX SM Crystals 10.0 to 100MHz. 220

14SMX SM Crystals 16.0 to 110MHz. 222

HC49/4HSMX Crystals 3.2 to 27.0MHz. 224

STOCK SURFACE MOUNT CRYSTALS

90SMX & 91SMX CRYSTALS

Frequency	Holder	Specification	Stock No.
32.7680KHz	90SMX	20/-/-/12.5	A103D
32.7680KHz	91SMX	20/-/-/12.5	A103E
See Quartz-Check watch crystal timer on page 28			

86SMX CRYSTALS

Frequency	Holder	Specification	Stock No.
3.579545MHz	86SMX	50/100/20/16	A119B
3.68640MHz	86SMX	50/100/20/16	A169B
4.0MHz	86SMX	50/100/20/30	A120C
4.194304MHz	86SMX	50/100/20/12	A123C
4.433619MHz	86SMX	50/100/20/16	A124C
4.91520MHz	86SMX	50/100/20/16	A127C
6.0MHz	86SMX	50/100/20/30	A132C
6.1440MHz	86SMX	50/100/20/20	A133C
7.37280MHz	86SMX	50/100/20/16	A194C
8.0MHz	86SMX	50/100/20/16	A140C
10.0MHz	86SMX	50/100/20/20	A143C
11.05920MHz	86SMX	50/100/20/20	L108B
12.0MHz	86SMX	50/100/20/30	A158C
12.0MHz	86SMX	50/100/20/16	A158D
12.2880MHz	86SMX	50/100/20/16	A175C
14.31818MHz	86SMX	50/100/20/16	A153C
14.74560MHz	86SMX	50/100/20/16	A159C
16.0MHz	86SMX	50/100/20/16	A161B
16.0MHz	86SMX	50/100/20/20	A161D
16.3840MHz	86SMX	50/100/20/20	A178C
17.73447MHz	86SMX	50/100/20/16	A180C
18.4320MHz	86SMX	50/100/20/20	A146C
20.0MHz	86SMX	50/100/20/16	A147B
24.0MHz	86SMX	50/100/20/16	A189C

CX1V-T SM CRYSTALS

Frequency	Holder	Specification	Stock No.
32.7680KHz	CX1V-T SM	30/180/40/9	C113G
See Quartz-Check watch crystal timer on page 28			

12SMX SM CRYSTALS

Frequency	Holder	Specification	Stock No.
Various frequencies & specifications are available from stock, please contact our sales office.			

14SMX CRYSTALS

Frequency	Holder	Specification	Stock No.
19.6608MHz	14SMX	15/30/20/18 Fund	A182R
24.00014MHz	14SMX	15/30/20/18 Fund	A210R
26.39998MHz	14SMX	15/30/20/18 Fund	A218R
35.2512MHz	14SMX	15/30/20/18 3rd O/T	A216R
38.00053MHz	14SMX	15/30/20/18 3rd O/T	A219R

HC49/4HSMX CRYSTALS

Frequency	Holder	Specification	Stock No.
3.579545MHz	HC49/4HSMX	30/50/10/16	A119E
3.68640MHz	HC49/4HSMX	30/50/10/16	A169E
4.0MHz	HC49/4HSMX	30/50/10/16	A120E
4.433619MHz	HC49/4HSMX	30/50/10/16	A124E
4.91520MHz	HC49/4HSMX	30/50/10/16	A127E
6.0MHz	HC49/4HSMX	30/50/10/16	A132E
7.37280MHz	HC49/4HSMX	30/50/10/16	A194F
8.0MHz	HC49/4HSMX	30/50/10/16	A140E
10.0MHz	HC49/4HSMX	30/50/10/16	A143G
11.05920MHz	HC49/4HSMX	30/50/10/16	L108E
12.0MHz	HC49/4HSMX	30/50/10/16	A158E
16.0MHz	HC49/4HSMX	30/50/10/16	A161G
20.0MHz	HC49/4HSMX	30/50/10/16	A147E
24.0MHz	HC49/4HSMX	30/50/10/16	A189E

SURFACE MOUNT CRYSTALS - Delivery Options

90SMX & 91SMX SM CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
20.0 to 200kHz	±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	6 to 12 weeks	212
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		

86SMX SM CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
3.57 to 70.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	4 to 12 weeks	214
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		

CX1V-T SM CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
10.0 to 74.999kHz	±30 to ±10,000ppm	–90ppm	–10 to 70°C	2 to 12 weeks	216
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
75.0 to 200.999kHz	±50 to ±10,000ppm	–90ppm	–10 to 70°C		
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
201.0kHz to 2.0MHz	±100 to ±10,000ppm	–90ppm	–10 to 70°C		
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
8.0 to 32.0MHz	±50 to ±1,000ppm	±30ppm	–10 to 70°C		218
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
Please note that higher frequencies are available upon request; please contact our sales office.					

12SMX SM CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
10.0 to 100.0MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	–10 to 60°C	6 to 10 weeks	220

14SMX SM CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
16.0 to 110.0MHz	±10ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C up to –10 to 60°C	6 to 10 weeks	222

HC49/4HSMX CRYSTALS

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	Delivery Options	Full Specification Page
3.2 to 27.0MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	6 to 10 weeks	224

90SMX & 91SMX SM CRYSTALS 20 to 200kHz

ISSUE 4; 21 MARCH 1994

Holder Style

- 90SMX & 91SMX surface mount crystals are plastic encapsulated

General Specifications

- Load Capacitance (C_L): 12.5pf
- Drive Level: 1.0µWmax

Packaging

- 90SMX & 91SMX surface mount crystals are available packaged individually or on tape and reel

Standard Frequency Tolerances and Stabilities

- ±100ppm, ±150ppm, ±200ppm, ±300ppm

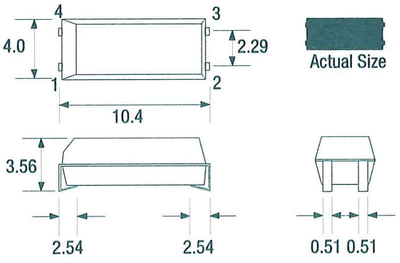
Standard Operating Temperature Ranges

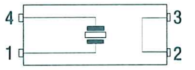
- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C

Standard Storage Temperature Range

- –55 to 125°C

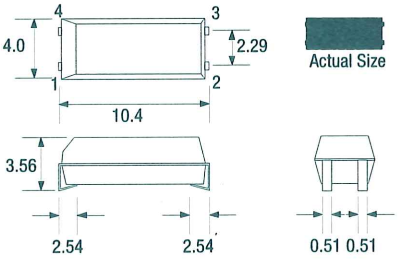
Outline - 90SMX (scale 2:1)

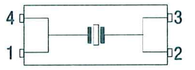




Electrical connection

Outline - 91SMX (scale 2:1)





Electrical connection

Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
20.0 to 99.999kHz	±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	35kΩ to 15kΩ	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		
100.0 to 200.0kHz	±100ppm	±50ppm to ±300ppm	0 to 50°C up to –10 to 60°C	12kΩ to 8kΩ	Fundamental
		±100ppm to ±300ppm	0 to 50°C up to –20 to 70°C		
		±150ppm to ±300ppm	0 to 50°C up to –30 to 80°C		
		±200ppm to ±300ppm	0 to 50°C up to –40 to 90°C		

86SMX & 86SMXLP SM CRYSTALS 3.57 to 60MHz

ISSUE 2; 21 MARCH 1994

Holder Style

- 86SMX surface mount crystals are plastic encapsulated

General Specifications

- Load Capacitance (C_L): 10pf to 50pf or Series
- Drive Level: 10μW typ, 100μW max

Packaging

- 86SMX surface mount crystals are available packaged individually or on tape and reel

Standard Frequency Tolerances and Stabilities

- ±10ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm, ±150ppm, ±200ppm, ±300ppm

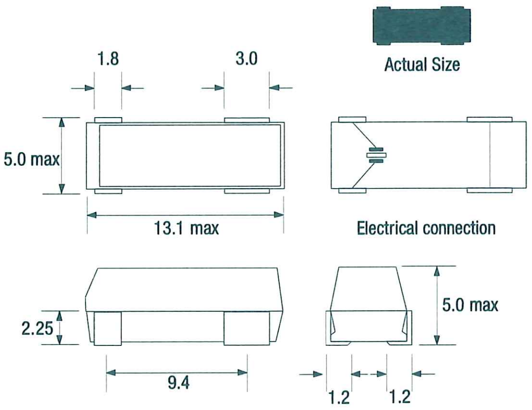
Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C
  –20 to 70°C
  –30 to 80°C
  –40 to 90°C

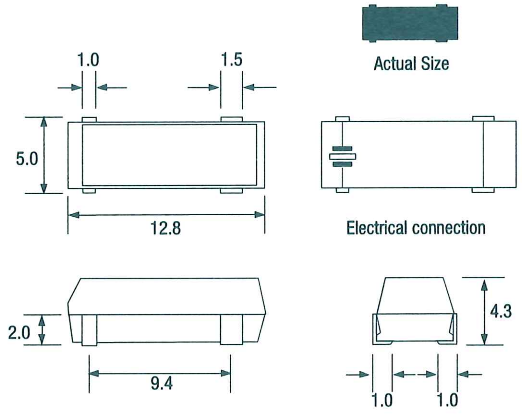
Standard Storage Temperature Range

- –55 to 125°C

Outline (scale 2:1)



Outline 86SMXLP (scale 2:1)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
3.57 to 3.699MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	200Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
3.70 to 3.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	180Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
4.0 to 5.2MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	150Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
5.0 to 9.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	120Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
10.0 to 15.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	50Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
16.0 to 25.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	40Ω	Fundamental
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
26.0 to 35.999MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	100Ω	3rd Overtone
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		
36.0 to 70.0MHz	±30ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C	80Ω	3rd Overtone
		±20ppm to ±100ppm	0 to 50°C up to –10 to 60°C		
		±30ppm to ±100ppm	0 to 50°C up to –20 to 70°C		
		±50ppm to ±100ppm	0 to 50°C up to –40 to 90°C		

CX1V-T SM CRYSTALS 10kHz to 2.0MHz

ISSUE 1; 10 AUGUST 1992

Description

CX1V-T crystals are high quality chemically etched - resonators manufactured with a photolithographic process Intended for use in simple pierce oscillators, they are tuning fork resonators over the frequency range 10kHz to 560kHz and length extensional resonators over the range 561kHz to 2MHz

Holder Style

- CX1V-T crystals are housed in a ceramic package, hermetically sealed, with a soft soldered glass lid.

Methods of Attachment

- CX1V-T is intended for surface mounting by reflow soldering at approximately 260°C for 20 seconds. The contact pads are Au plated.
- CX1V-T2 is intended for surface mounting by reflow soldering at approximately 260°C for 20 seconds. The contact pads are NiSn plated.

General Specifications

- Load Capacitance (C_L):
  9pf (10.0 to 100.999kHz)
  4pf (101.0 to 560.999kHz)
  10pf (561.0kHz to 2.0MHz)
  Other values available upon request
- Shunt Capacitance (C_O): 1.0 to 3.0pf
- Drive Level:
  0.5μW max (10.0 to 20.999kHz)
  1.0μW max (21.0kHz to 2.0MHz)
- Aging: ±3ppm max first year

Standard Frequency Tolerances and Stabilities

- ±30ppm, ±50ppm, ±100ppm, ±500ppm, ±10000ppm

Standard Operating Temperature Ranges

- –40 to 80°C
- –55 to 125°C

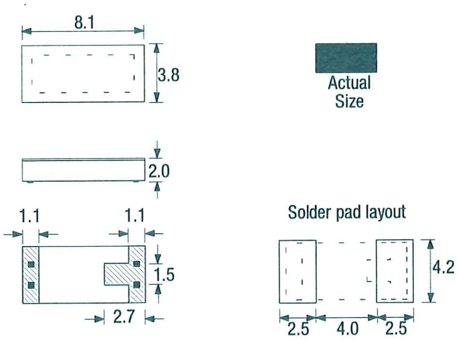
Standard Storage Temperature Range

- –55 to 125°C

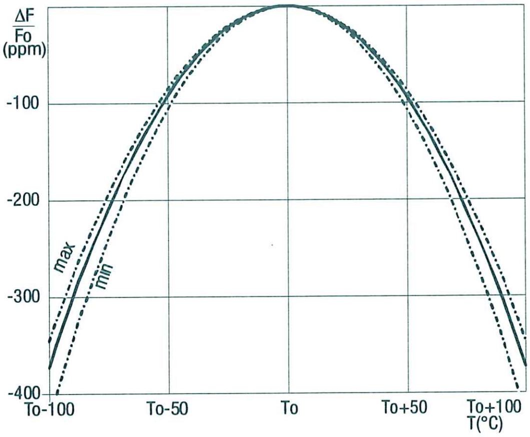
Environmental Specification

- Shock: 5000g, 0.3mS ½ sine
- Vibration: 20g, 10 to 2000Hz

Outline (scale 2:1)



Frequency Temperature Curve

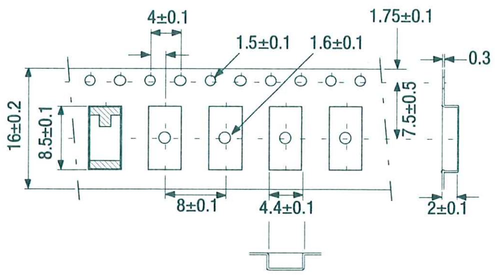


$\Delta F/F_o = -0.038 ppm/°C^2 \, (T-T_0)^2 \pm 10\%$

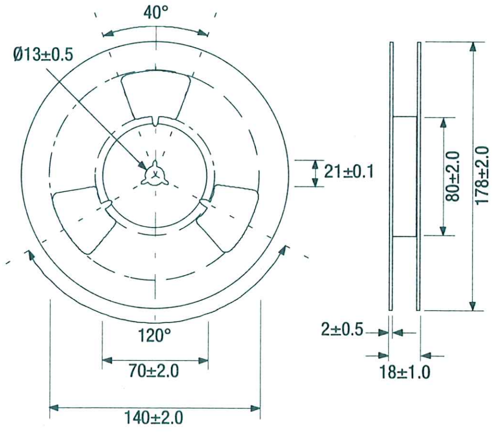
Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 20.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	200kΩ to 150kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
21.0 to 49.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	150kΩ to 80kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
50.0 to 74.999kHz	±30 to ±10000ppm	–90ppm	–10 to 70°C	80kΩ to 50kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
75.0 to 99.999kHz	±50 to ±10000ppm	–90ppm	–10 to 70°C	50kΩ to 40kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
100.0 to 200.999kHz	±50 to ±10000ppm	–90ppm	–10 to 70°C	40kΩ to 20kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
201.0 to 299.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	9kΩ	3rd Overtone
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
300.0 to 560.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	9kΩ to 20kΩ	3rd Overtone
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
561.0 to 999.999kHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
1.0 to 1.599MHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		
1.6 to 2.0MHz	±100 to ±10000ppm	–90ppm	–10 to 70°C	1.5kΩ	Fundamental
		–150ppm	–40 to 85°C		
		–350ppm	–55 to 125°C		

Outline - Tape



Outline - Reel (scale 1:5)



CX1V-T SM CRYSTALS 8 to 32MHz

ISSUE 2; 10 SEPTEMBER 1993

Description

CX1 crystals are high quality chemically etched resonators manufactured with a photolithographic process

Holder Style

- CX1 crystals are housed in a ceramic package, hermetically sealed, with a soft soldered glass lid.

General Specifications

- Load Capacitance (C_L): 20pF
  Other values available upon request
- Shunt Capacitance (C_O): 2.0 to 5.0pf
- Drive Level:
  500μW max
- Aging: ±3ppm max first year

Standard Frequency Tolerances and Stabilities

- ±50ppm, ±100ppm, ±250ppm, ±10,000ppm

Standard Operating Temperature Ranges

- –40 to 80°C
- –55 to 125°C

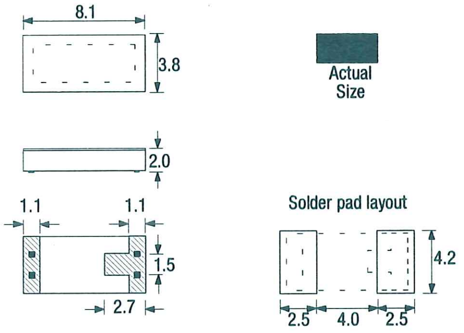
Standard Storage Temperature Range

- –55 to 125°C

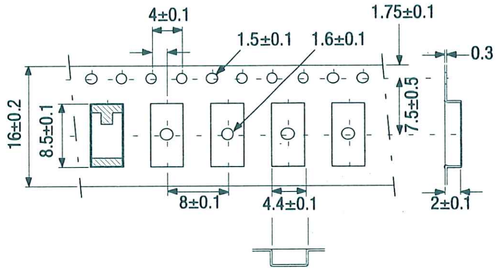
Environmental Specification

- Shock: 5000g, 0.3mS ½ sine
- Vibration: 20g, 10 to 2000Hz

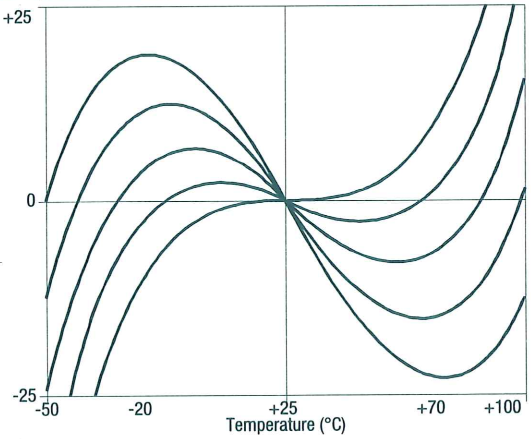
Outline (scale 2:1)



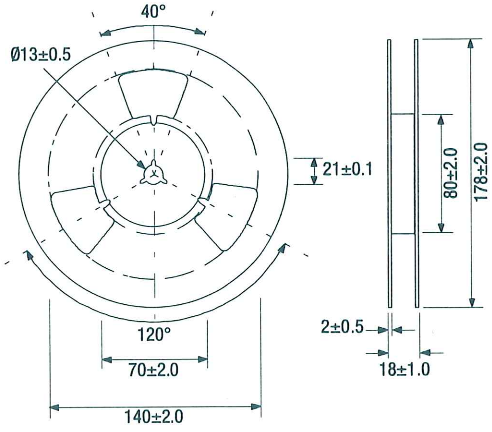
Outline - Tape



Frequency Temperature Curve



Outline - Reel (scale 1:5)



Electrical Specification – Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
8.0 to 9.999MHz	±50 to ±1000ppm	±30ppm	–10 to 70°C	100Ω	Fundamental AT cut
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
10.0 to 12.999MHz	±50 to ±1000ppm	±30ppm	–10 to 70°C	75Ω	Fundamental AT cut
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
13.0 to 25.999MHz	±50 to ±1000ppm	±30ppm	–10 to 70°C	50Ω	Fundamental AT cut
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
26.0 to 32.0MHz	±50 to ±1000ppm	±30ppm	–10 to 70°C	75Ω	Fundamental AT cut
		±50ppm	–40 to 85°C		
		±100ppm	–55 to 125°C		
Please note that higher frequencies are available upon request; please contact our sales office.					

12SMX SM CRYSTALS 10.0 to 100MHz

Holder Style

- 12SMX surface mount crystals are encapsulated in a ceramic package

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 500μW max
- Shunt Capacitance (C_O): 7pf max

Packaging

- 12SMX surface mount crystals are available packaged individually or on tape and reel

Standard Frequency Tolerances and Stabilities

- ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- −10 to 60°C

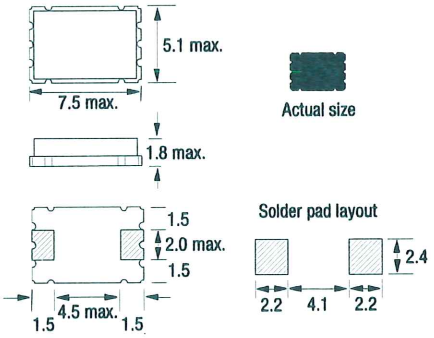
Standard Storage Temperature Range

- −55 to 125°C

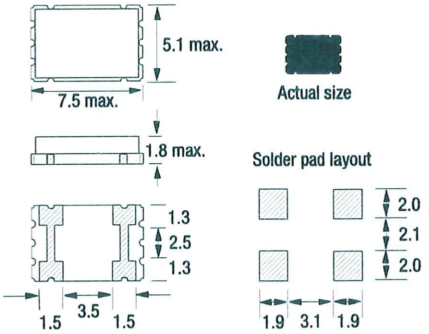
Marking

- Includes type number and frequency

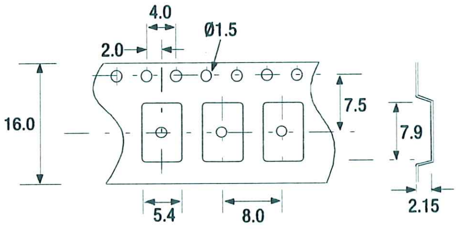
Outline - Type A (scale 2:1)



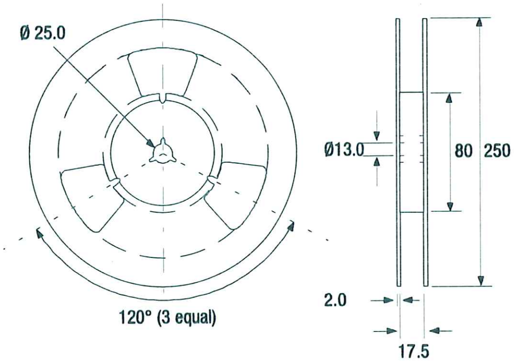
Outline - Type C (scale 2:1)



Outline - Tape



Outline - Reel (scale 1:5)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
10.0 to 15.999MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	–10 to 60°C	60Ω	Fundamental AT cut
16.0 to 32.0MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	–10 to 60°C	40Ω	Fundamental AT cut
28.0 to 71.999MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	–10 to 60°C	60Ω	3rd Overtone AT cut
72.0 to 100.0MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	–10 to 60°C	80Ω	3rd Overtone AT cut

14SMX SM CRYSTALS 16.0 to 110MHz

Holder Style

- 14SMX surface mount crystals are encapsulated in a ceramic package

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 100µW max
- Shunt Capacitance (C_O): 7pf max

Packaging

- 14SMX surface mount crystals are available packaged individually or on tape and reel

Standard Frequency Tolerances and Stabilities

- ±10ppm, ±20ppm, ±30ppm, ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C

Standard Storage Temperature Range

- –55 to 125°C

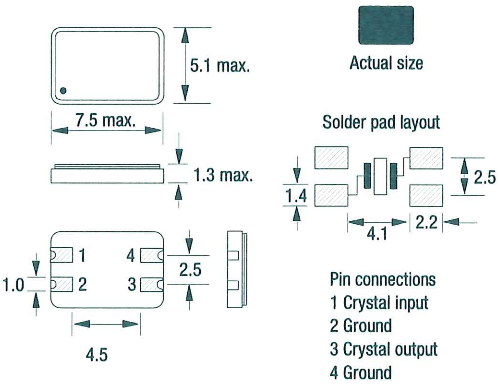
Marking

- Includes type number and frequency

Packaging

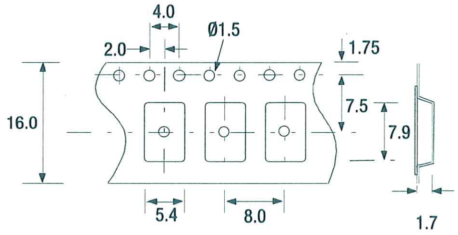
- 14SMX surface mount crystals are available individually packaged or on tape and reel

Outline (scale 2:1)

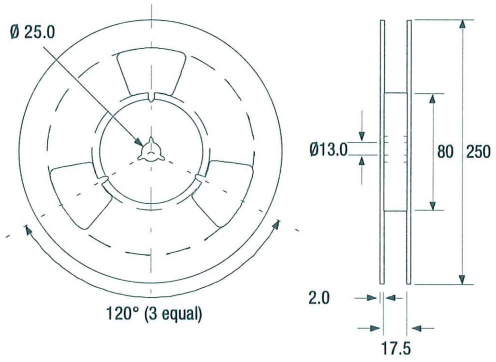


Pin connections
1 Crystal input
2 Ground
3 Crystal output
4 Ground

Outline - Tape



Outline - Reel (scale 1:5)



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
16.0 to 32.0MHz	±10ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C up to –10 to 60°C	40Ω	Fundamental AT cut
32.1 to 84.0MHz	±10ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C up to –10 to 60°C	60Ω	3rd Overtone AT cut
84.1 to 110.0MHz	±10ppm to ±100ppm	±10ppm to ±100ppm	0 to 50°C up to –10 to 60°C	80Ω	5th Overtone AT cut

HC49/4HSMX CRYSTALS 3.2 to 27.0MHz

ISSUE 4; 21 MARCH 1994

Holder Style

- HC49/4HSMX crystals are resistance welded, hermetically sealed in an inert atomosphere with glass to metal seals securing the lead wires. The lead wires are formed into a gull wing and mounted on a plastic former

General Specifications

- Load Capacitance (C_L): 5pf to 75pf or Series
- Drive Level: 100μW max
- Shunt Capacitance (C_0): 9pf max
- Aging: ±3ppm typical per year

Standard Frequency Tolerances and Stabilities

- ±50ppm, ±100ppm

Standard Operating Temperature Ranges

- 0 to 50°C
  –10 to 60°C

Standard Storage Temperature Range

- –20 to 85°C

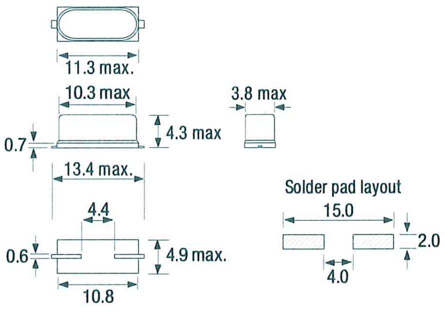
Marking

- Includes Frequency

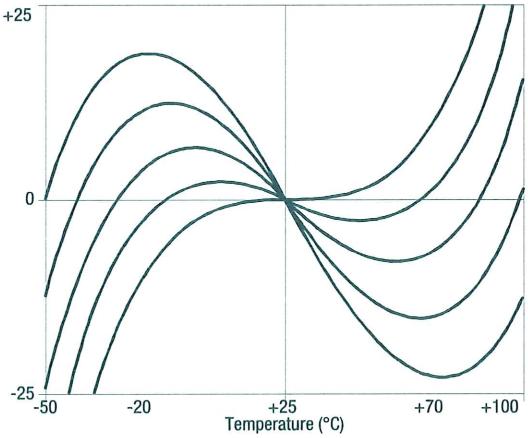
Environmental Specification

- Shock: 981m/S^2 for 6mS, three shocks in each direction along three mutually perpendicular planes
- Vibration: 10 to 60Hz 0.75mm displacement, 60 to 2000Hz 98.1m/S^2 acceleration, 30 minutes in each of three mutually perpendicular planes

Outline



Typical Frequency vs Temperature Curves for various angles of AT-cut crystals



Electrical Specification - Maximum Limiting Values

Frequency Range	Frequency Tolerance @ 25°C ±2°C	Frequency Stability	Operating Temperature Range	ESR Max	Vibration Mode
3.2 to 3.49MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	300Ω	Fundamental
3.5 to 3.99MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	150Ω	Fundamental
4.0 to 5.999MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	120Ω	Fundamental
6.0 to 8.999MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	80Ω	Fundamental
9.0 to 9.999MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	60Ω	Fundamental
10.0 to 27.0MHz	±50ppm to ±100ppm	±50ppm to ±100ppm	0 to 50°C up to –10 to 60°C	50Ω	Fundamental

SM CLOCK OSCILLATORS - Section Contents

Stock SM Clock Oscillators 228

SM Clock Oscillators - Delivery Options 229

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IQXO-60 238

IQXO-61 240

IQXO-64 242

IQXO-65 244

STOCK SM CLOCK OSCILLATORS

IQXO-53

Frequency	Type	Frequency Stability	Stock No.
4.0MHz	HCMOS	±100ppm	X351L
4915.2kHz	HCMOS	±100ppm	X385L
8.0MHz	HCMOS	±100ppm	X352L
10.0MHz	HCMOS	±100ppm	X353L
12.0MHz	HCMOS	±100ppm	X354L
14.31818MHz	HCMOS	±100ppm	X373L
16.0MHz	HCMOS	±100ppm	X355L
18.4320MHz	HCMOS	±100ppm	X367L
20.0MHz	HCMOS	±100ppm	X356L
24.0MHz	HCMOS	±100ppm	X371L
24.45760MHz	HCMOS	±100ppm	X386L
32.0MHz	HCMOS	±100ppm	X360L
33.333MHz	HCMOS	±100ppm	X387L
40.0MHz	HCMOS	±100ppm	X357L
50.0MHz	HCMOS	±100ppm	X358L

IQXO-65

Frequency	Type	Frequency Stability	Stock No.
4.0MHz	HCMOS	±100ppm	X351S
4915.2kHz	HCMOS	±100ppm	X385S
8.0MHz	HCMOS	±100ppm	X352S
10.0MHz	HCMOS	±100ppm	X353S
12.0MHz	HCMOS	±100ppm	X354S
14.31818MHz	HCMOS	±100ppm	X373S
16.0MHz	HCMOS	±100ppm	X355S
18.4320MHz	HCMOS	±100ppm	X367S
20.0MHz	HCMOS	±100ppm	X356S
24.0MHz	HCMOS	±100ppm	X371S
24.45760MHz	HCMOS	±100ppm	X386S
32.0MHz	HCMOS	±100ppm	X360S
33.333MHz	HCMOS	±100ppm	X387S
40.0MHz	HCMOS	±100ppm	X357S
50.0MHz	HCMOS	±100ppm	X358S

SM CLOCK OSCILLATORS - Delivery Options

Standard TTL Surface Mount Oscillators

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 1.4999MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-52	4 to 10 weeks	230
1.5 to 60.0MHz	±50ppm, ±100ppm	0 to 70°C			
			IQXO-60	6 to 10 weeks	238
60.0 to 70.0MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-52	4 to 10 weeks	230

Tri-State Standard TTL Surface Mount Oscillators

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 1.4999MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-56	4 to 10 weeks	234
1.5 to 60.0MHz	±50ppm, ±100ppm	0 to 70°C			
			IQXO-64	6 to 10 weeks	242
60.0 to 70.0MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-56	4 to 10 weeks	234

HCMOS Surface Mount Oscillators

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 1.4999MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-53	4 to 10 weeks	232
1.5 to 60.0MHz	±50ppm, ±100ppm	0 to 70°C			
			IQXO-61	6 to 10 weeks	240
60.0 to 70.0MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-53	4 to 10 weeks	232

Tri-State HCMOS Surface Mount Oscillators

Frequency Range	Frequency Stability	Operating Temperature Range	Model	Delivery Options	Full Specification Page
1.0 to 1.4999MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-57	4 to 10 weeks	236
1.5 to 60.0MHz	±50ppm, ±100ppm	0 to 70°C			
			IQXO-65	6 to 10 weeks	244
60.0 to 70.0MHz	±50ppm, ±100ppm	0 to 70°C	IQXO-57	4 to 10 weeks	236

IQXO-52

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Output Compatibility

- Standard TTL

Holder Style

- SMD (surface mount device) plastic encapsulated

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –50 to 125°C

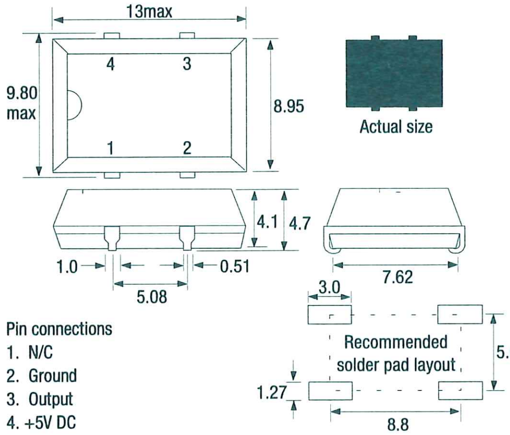
Marking

- Includes Type Number, Frequency, Date Code

Non-Standard Duty Cycle

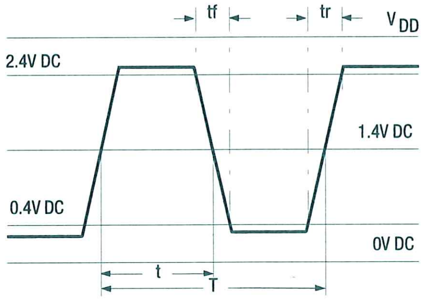
- Tighter duty cycles are available on request

Outline (scale 2:1)



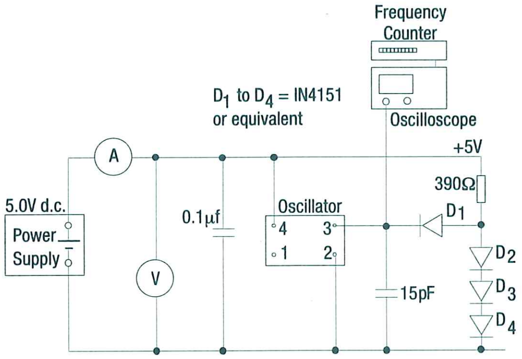
Pin connections
1. N/C
2. Ground
3. Output
4. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 29.999MHz	±50ppm, ±100ppm	5V±0.5V	15mA	10std TTL	8nS	8nS	40/60%	IQXO-52
30.0 to 39.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std TTL	8nS	8nS	40/60%	IQXO-52
40.0 to 49.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std TTL	6nS	6nS	40/60%	IQXO-52
50.0 to 70.0MHz	±50ppm, ±100ppm	5V±0.5V	38mA	5std TTL	6nS	6nS	40/60%	IQXO-52

IQXO-53

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Output Compatibility

- 10std HCMOS

Holder Style

- SMD (surface mount device) plastic encapsulated

Standard Frequency Stabilities

- ±50ppm, ±100ppm (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –50 to 125°C

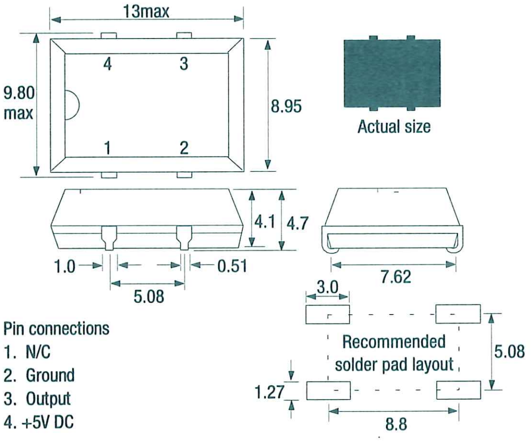
Marking

- Includes Type Number, Frequency, Date Code

Non-Standard Duty Cycle

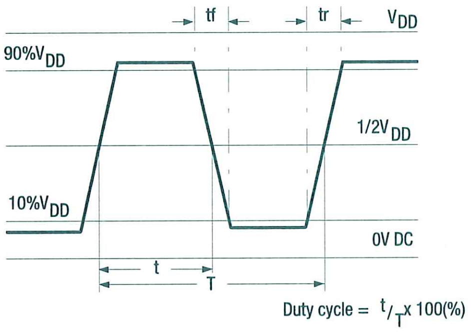
- Tighter duty cycles are available on request

Outline (scale 2:1)



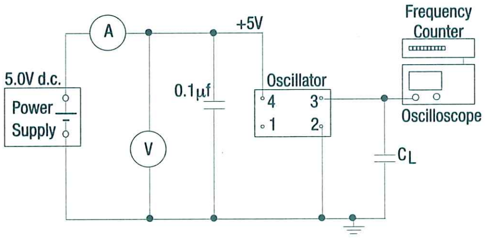
Pin connections
1. N/C
2. Ground
3. Output
4. +5V DC

Output Waveform



Duty cycle = $^{t}/_{T}$ x 100(%)

Test Circuit



C_L= 50pF (1.0 to 50.0MHz)
C_L= 30pF (50.0 to 70.0MHz)

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 29.999MHz	±50ppm, ±100ppm	5V±0.5V	15mA	10std HCMOS 50pF	8nS	8nS	40/60%	IQXO-53
30.0 to 39.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std HCMOS 50pF	8nS	8nS	40/60%	IQXO-53
40.0 to 49.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std HCMOS 50pF	6nS	6nS	40/60%	IQXO-53
50.0 to 70.0MHz	±50ppm, ±100ppm	5V±0.5V	38mA	6std HCMOS 30pF	6nS	6nS	40/60%	IQXO-53

IQXO-56

ISSUE 4; 21 MARCH 1994

Output Compatibility

- Tri-state Standard TTL

Holder Style

- SMD (surface mount device) plastic encapsulated

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –50 to 125°C

Marking

- Includes Type Number, Frequency, Date Code

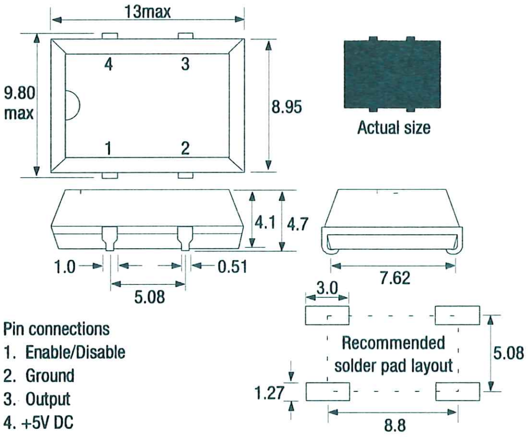
Non-Standard Duty Cycle

- Tighter duty cycles are available on request

Tri-state Operation

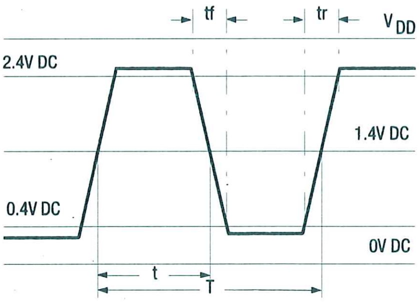
- Logic ‘1’ to pin 1 enables oscillator output, 2.0V min
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state, 0.8V max
- No connection to pin 1 enables oscillator output
- When oscillator is enabled, maximum transition time = 100nS

Outline (scale 2:1)



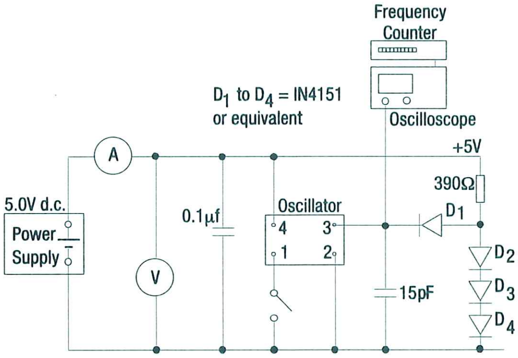
Pin connections
1. Enable/Disable
2. Ground
3. Output
4. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit



Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 29.999MHz	±50ppm, ±100ppm	5V±0.5V	15mA	10std TTL	8nS	8nS	40/60%	IQXO-56
30.0 to 39.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std TTL	8nS	8nS	40/60%	IQXO-56
40.0 to 49.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std TTL	6nS	6nS	40/60%	IQXO-56
50.0 to 70.0MHz	±50ppm, ±100ppm	5V±0.5V	38mA	5std TTL	6nS	6nS	40/60%	IQXO-56

IQXO-57

ISSUE 5; 21 MARCH 1994

Output Compatibility

- Tri-state HCMOS

Holder Style

- SMD (surface mount device) plastic encapsulated

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –50 to 125°C

Marking

- Includes Type Number, Frequency, Date Code

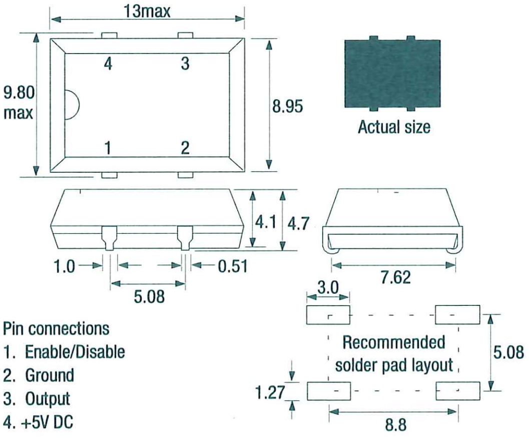
Non-Standard Duty Cycle

- Tighter duty cycles are available on request

Tri-state Operation

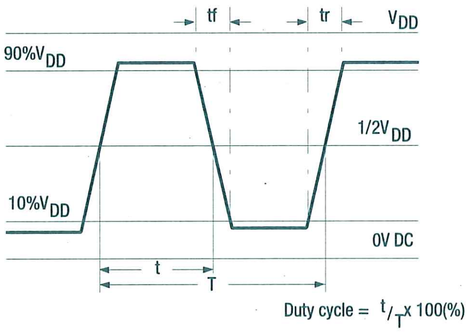
- Logic ‘1’ to pin 1 enables oscillator output, 2.0V min
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state, 0.8V max
- No connection to pin 1 enables oscillator output
- When oscillator is enabled, maximum transition time = 100nS

Outline (scale 2:1)

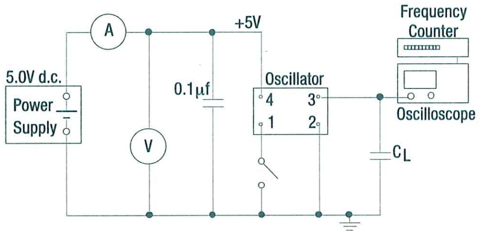


Pin connections
1. Enable/Disable
2. Ground
3. Output
4. +5V DC

Output Waveform



Test Circuit



C_L= 50pF (1.0 to 49.999MHz)
C_L= 30pF (50.0 to 70.0MHz)

Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.0 to 29.999MHz	±50ppm, ±100ppm	5V±0.5V	15mA	10std HCMOS 50pF	8nS	8nS	40/60%	IQXO-57
30.0 to 39.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std HCMOS 50pF	8nS	8nS	40/60%	IQXO-57
40.0 to 49.999MHz	±50ppm, ±100ppm	5V±0.5V	30mA	10std HCMOS 50pF	6nS	6nS	40/60%	IQXO-57
50.0 to 70.0MHz	±50ppm, ±100ppm	5V±0.5V	38mA	6std HCMOS 30pF	6nS	6nS	40/60%	IQXO-57

IQXO-60

ISSUE 2; 21 MARCH 1994

Output Compatibility

- Standard TTL

Holder Style

- SMD (surface mount device) ceramic package

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

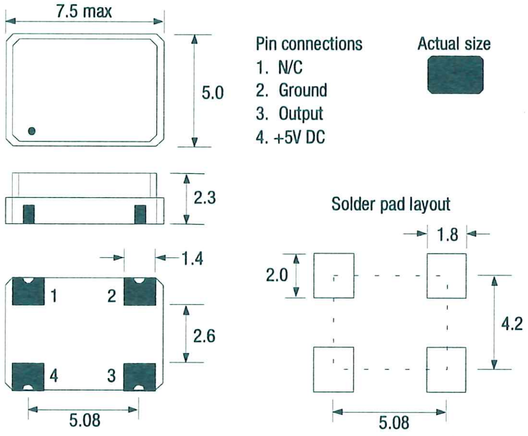
Standard Storage Temperature Range

- –55 to 125°C

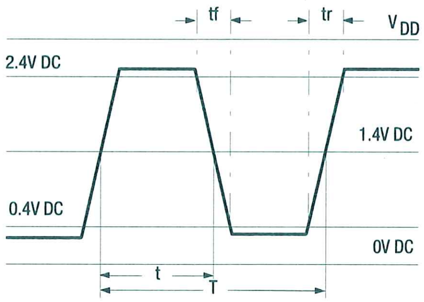
Marking

- Includes Type Number and Frequency

Outline (scale 3:1)

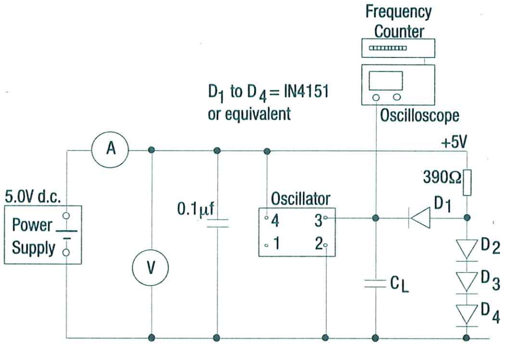


Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit

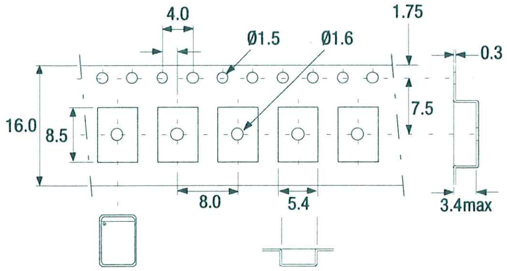


C_L= 50pF (1.0 to 49.999MHz)
C_L= 30pF (50.0 to 60.0MHz)

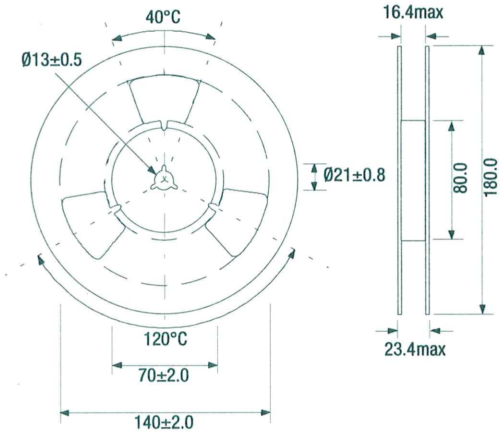
Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.5 to 24.999MHz	±50ppm, ±100ppm	5.0V±0.5V	25mA	10std TTL	10nS	10nS	40/60%	IQXO-60
25.0 to 49.999MHz	±50ppm, ±100ppm	5.0V±0.5V	45mA	10std TTL	10nS	10nS	40/60%	IQXO-60
50.0 to 60.0MHz	±50ppm, ±100ppm	5.0V±0.5V	60mA	10std TTL	10nS	10nS	40/60%	IQXO-60

Outline - Tape



Outline - Reel



IQXO-61

ISSUE 2; 21 MARCH 1994

Output Compatibility

- Standard HCMOS

Holder Style

- SMD (surface mount device) ceramic package

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

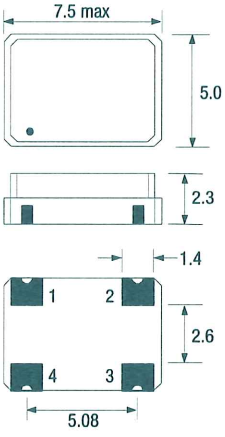
Standard Storage Temperature Range

- –55 to 125°C

Marking

- Includes Type Number and Frequency

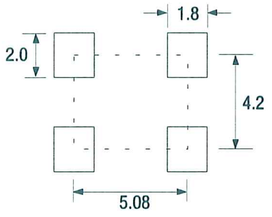
Outline (scale 3:1)



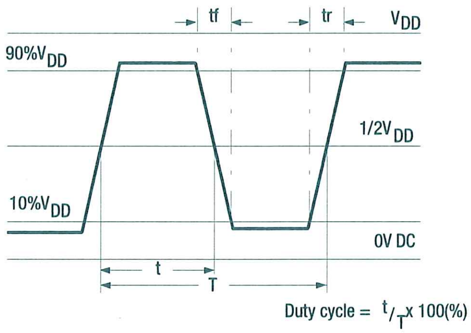
Pin connections
1. N/C
2. Ground
3. Output
4. +5V DC

Actual size

Solder pad layout

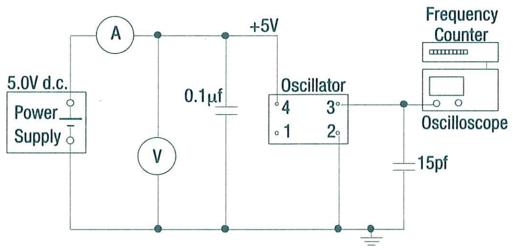


Output Waveform



Duty cycle = $^{t}/_{T}$ x 100(%)

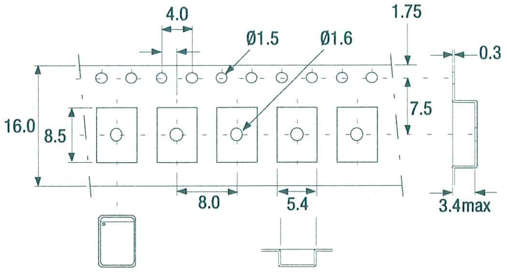
Test Circuit



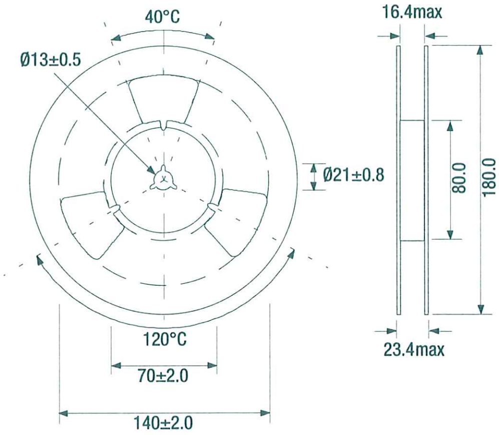
Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.5 to 19.999MHz	±50ppm, ±100ppm	5.0V±0.5V	20mA	10std HCMOS	10nS	10nS	40/60%	IQXO-65
20.0 to 60.0MHz	±50ppm, ±100ppm	5.0V±0.5V	35mA	10std HCMOS	10nS	10nS	40/60%	IQXO-65

Outline - Tape



Outline - Reel



IQXO-64

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Output Compatibility

- Tri-state Standard TTL

Holder Style

- SMD (surface mount device) ceramic package

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

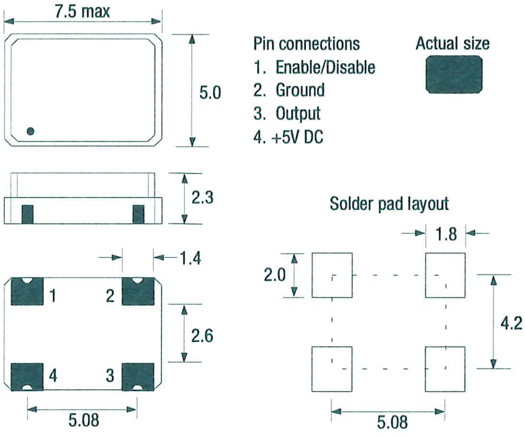
Marking

- Includes Type Number and Frequency

Tri-state Operation

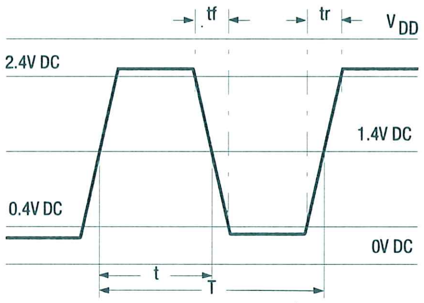
- Logic ‘1’ to pin 1 enables oscillator output, 2.2V min
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state, 0.8V max
- No connection to pin 1 enables oscillator output
- When oscillator is enabled, maximum transition time = 100nS

Outline (scale 3:1)



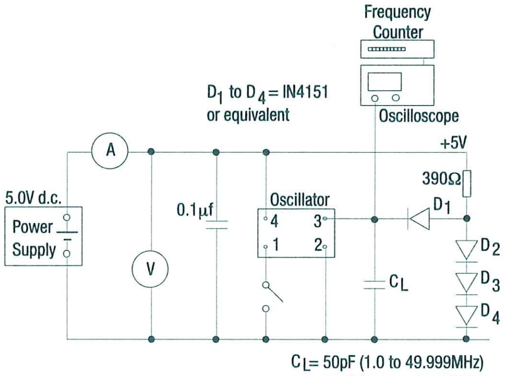
Pin connections
1. Enable/Disable
2. Ground
3. Output
4. +5V DC

Output Waveform



Duty cycle = t / T x 100(%)

Test Circuit

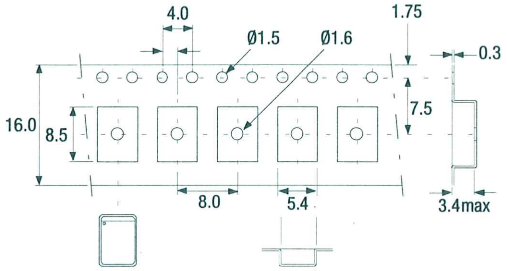


C_L= 50pF (1.0 to 49.999MHz)
C_L= 30pF (50.0 to 70.0MHz)

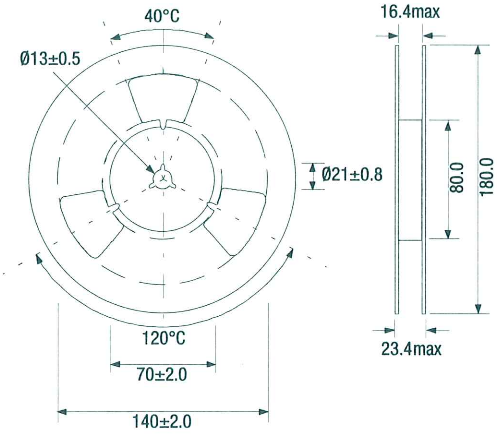
Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.5 to 24.999MHz	±50ppm, ±100ppm	5.0V±0.5V	25mA	10std TTL	10nS	10nS	40/60%	IQXO-64
25.0 to 49.999MHz	±50ppm, ±100ppm	5.0V±0.5V	45mA	10std TTL	10nS	10nS	40/60%	IQXO-64
50.0 to 59.999MHz	±50ppm, ±100ppm	5.0V±0.5V	60mA	10std TTL	10nS	10nS	40/60%	IQXO-64
60.0 to 67.0MHz	±100ppm	5.0V±0.5V	60mA	10std TTL	10nS	10nS	40/60%	IQXO-64

Outline - Tape



Outline - Reel



IQXO-65

ISSUE 2; 21 MARCH 1994

Output Compatibility

- Tri-state HCMOS

Holder Style

- SMD (surface mount device) ceramic package

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

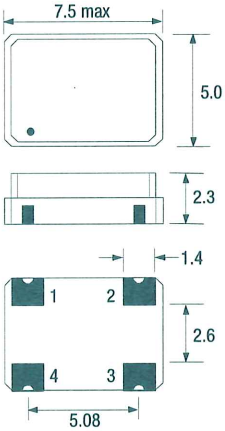
Marking

- Includes Type Number and Frequency

Tri-state Operation

- Logic ‘1’ to pin 1 enables oscillator output, 2.2V min
- Logic ‘0’ to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state, 0.8V max
- No connection to pin 1 enables oscillator output
- When oscillator is enabled, maximum transition time = 100nS

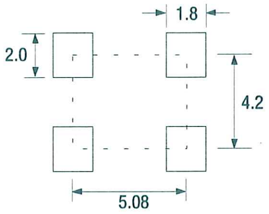
Outline (scale 3:1)



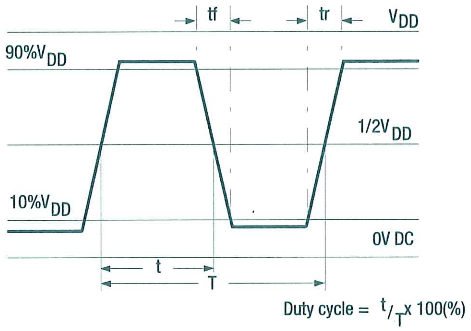
Pin connections
1. Enable/Disable
2. Ground
3. Output
4. +5V DC

Actual size

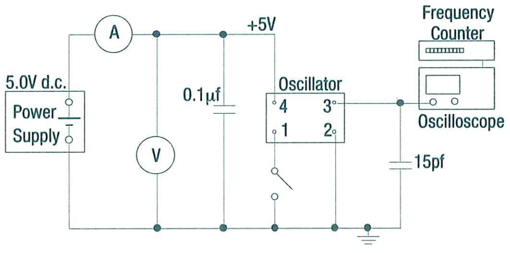
Solder pad layout



Output Waveform



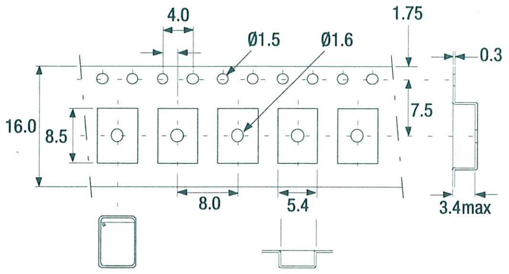
Test Circuit



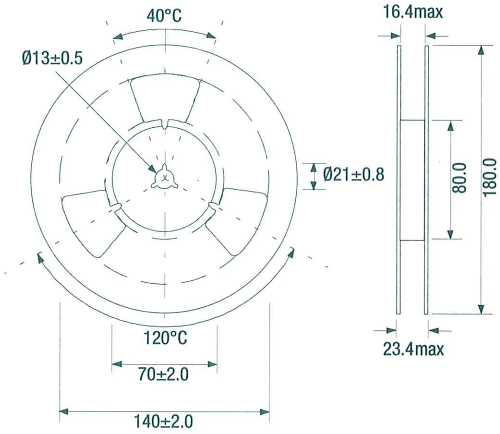
Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.5 to 19.999MHz	±50ppm, ±100ppm	5.0V±0.5V	20mA	10std HCMOS	10nS	10nS	40/60%	IQXO-65
20.0 to 60.0MHz	±50ppm, ±100ppm	5.0V±0.5V	35mA	10std HCMOS	10nS	10nS	40/60%	IQXO-65

Outline - Tape



Outline - Reel



IQXO-70

ISSUE 1; 1 FEBRUARY 1994

Output Compatibility

- Tri-state HCMOS

Holder Style

- SMD (surface mount device) ceramic package

Standard Frequency Stabilities

- ±50ppm, ±100ppm
  (inclusive of supply voltage & output load variations over the standard operating temperature range)

Standard Operating Temperature Range

- 0 to 70°C

Standard Storage Temperature Range

- –55 to 125°C

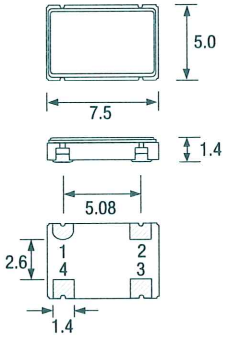
Marking

- Printed on oscillator surface, includes Type Number and Frequency

Tri-state Operation

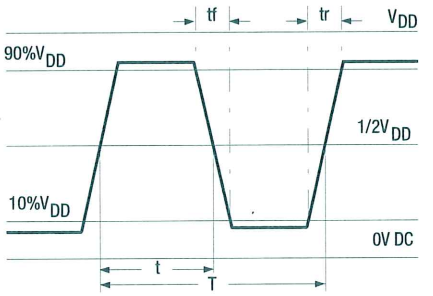
- Logic '1' to pin 1 enables oscillator output, 2.2V min
- Logic '0' to pin 1 disables oscillator output; when disabled the oscillator output goes to the high impedance state, 0.8V max
- No connection to pin 1 enables oscillator output
- When oscillator is enabled, maximum transition time = 100nS

Outline (scale 3:1)



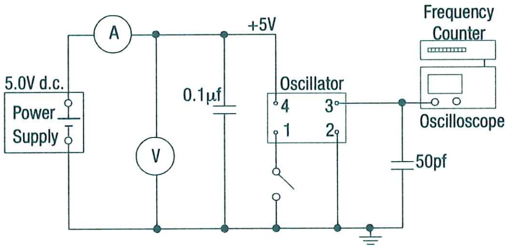
Pad connections:
1. Enable/Disable
2. Ground
3. Output
4. 5V D.C.

Output Waveform



Duty cycle = $t/_T$ x 100(%)

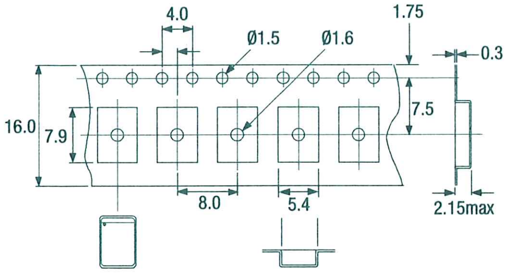
Test Circuit



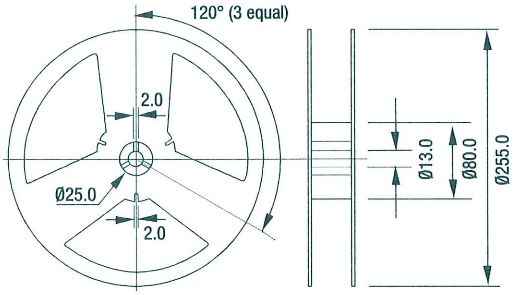
Electrical Specification – maximum limiting values when measured in test circuit

Frequency Range	Frequency Stability	Supply Voltage	Supply Current	Output Load	Rise Time (t_r)	Fall Time (t_f)	Duty Cycle	Model Number
1.8432 to 24.999MHz	±50ppm, ±100ppm	5.0V±0.5V	25mA	10std HCMOS	7nS	7nS	60/40%	IQXO-70
25.0 to 49.999MHz	±50ppm, ±100ppm	5.0V±0.5V	45mA	10std HCMOS	7nS	7nS	60/40%	IQXO-70
50.0 to 67.0MHz	±50ppm, ±100ppm	5.0V±0.5V	60mA	10std HCMOS	7nS	7nS	60/40%	IQXO-70

Outline - Tape



Outline - Reel



QUARTZ CRYSTALS

The importance of quartz crystal resonators in electronics results from their extremely high Q, relatively small size and excellent temperature stability.

A quartz crystal resonator utilizes the piezoelectric properties of quartz. If a stress is applied to a crystal in a certain direction, electric charges appear in the perpendicular direction.

Conversely, if an electric field is applied, it will cause mechanical deflection of the crystal. In a quartz crystal resonator, a thin slab of quartz is placed between two electrodes. An alternating voltage applied to these electrodes causes the quartz to vibrate.

If the frequency of this voltage is very near the mechanical resonance of the quartz slab, the amplitude of the vibrations will become very large. The strain of these vibrations causes the quartz to produce a sinusoidal electric field which controls the effective impedance between the two electrodes.

This impedance is strongly dependent on the excitation frequency and possesses an extremely high Q.

Electrically, a quartz crystal can be represented by the equivalent circuit of Fig. 1 where the Series combination R1, L1 and C1 represent the quartz and Co represents the shunt capacitance of the electrodes in parallel with the can capacitance. The inductor L1 is a function of the mass of the quartz while C1 is associated with its stiffness. The R1 results from the loss in the quartz and in the mounting arrangement. The parameters of the equivalent circuit can be measured quite accurately using the crystal impedance (CI) meters.

A reactance-frequency plot of the equivalent circuit is given in Fig. 2. There are many related formulae for crystal performance; the first of these is Fs. This is the frequency at which the crystal is series resonant and is given by:

$$F_s = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

Where
Fs=series resonant frequency in hertz
L1=motional arm inductance in henries
C1=motional arm capacitance in farads

Fig. 1; Equivalent Circuit of a Crystal

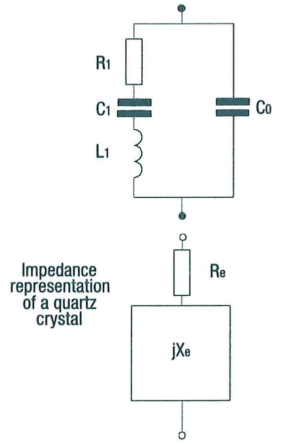
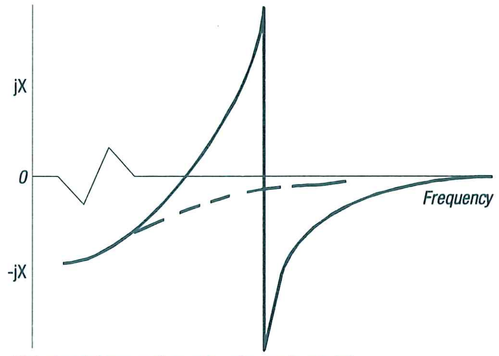


Fig. 2; Reactance vs Frequency



Plot of resistance vs frequency of a quartz crystal

Typical Crystal Parameter Values

Parameter	200kHz	2MHz	30MHz	90MHz
	Fundamental		Third o/t	Fifth o/t
R_1	2k	100Ω	20Ω	40Ω
L_1	27H	520mH	11mH	6mH
C_1	0.024pF	0.012pF	0.0026pF	0.0005pF
C_o	9pF	4pF	6pF	4pF
Q	$18x10^3$	$18x10^3$	18x103	18x103

Calibration Tolerance

Calibration tolerance is the maximum allowance error in frequency of a crystal at a specific temperature (usually 25°C).

Frequency Stability

The frequency stability of a crystal generally is limited by its temperature coefficient and aging rate. AT-cut crystals have a better temperature coefficient than most other cuts.

Common frequency tolerance specifications are ±0.005% or ±0.0025% from –55°C to +105°C. These include calibration tolerance; thus, the actual temperature coefficient is slightly better. Improved temperature coefficient can be obtained if the temperature range is limited. This can be seen in Fig. 3, which gives the frequency-temperature curves for AT-cut crystals. These curves may be represented by cubic equations and are strongly dependent on the angle of cut of the quartz blank. The points of zero temperature coefficient are called the turning points (lower and upper turning point temperatures). One turning point can be placed where desired by selecting the angle of cut; the other turning point then is determined, since the turning points are symmetrical about a point in the 20–30 degree range. The slope between the turning points becomes smaller as the turning points move together. Crystals designed for use in an oven should be cut so that the turning point occurs at the oven temperature. Fig. 4 shows the frequency temperature curves for several low frequency cuts. The J cut is used below 10kHz, while an XY cut may be used from 3kHz to 85kHz. An NT cut may be used in the 10kHz range. A DT cut is applicable from 100kHz to about 800kHz and a CT from 300kHz to 900kHz.

Fig. 3; Low Frequency Crystal

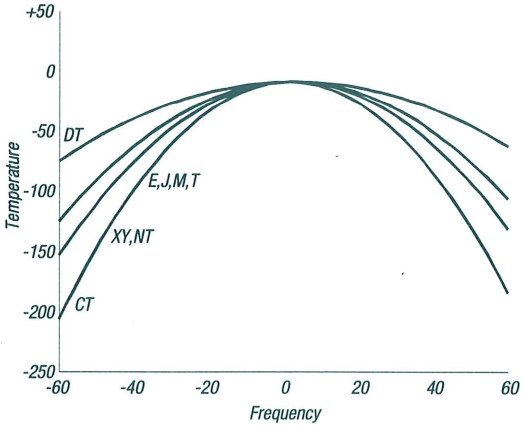
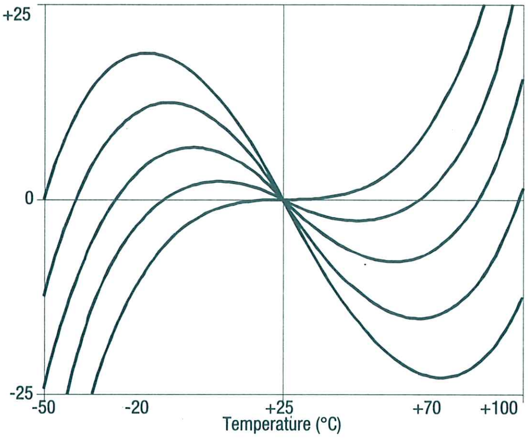


Fig. 4; AT Cut Frequency vs Temperature Curve



Load Capacitance

When a low capacitance load (high impedance) is used on the crystal, the major effect is higher oscillation frequency and a higher crystal output signal to the amplifier. Further increase in the value of the load capacitance causes the output frequency of the crystal to reduce, approaching the series resonant frequency. Fig. 7 shows the affect of load capacitance with respect to frequency.

If a high load impedance is used across the crystal terminals, the circuit is called parallel resonant. The crystal has a shunt terminal capacitance C_0 of its own, amounting to 3–15pF.

This shunt terminal capacitance C_0 is part of the external load on the crystal and must therefore be included in any calculations for crystal performance.

Pullability

The pullability of a crystal is the change in frequency as a function of change in the load capacitance. The load capacitance can be in series or in parallel with the crystal. Fig. 8 shows typical pullability of a crystal. The formula (all capacities in pF) to calculate pullability is:

$$\frac{(C_1)(10^6)}{2(C_o + C_L)^2}$$

where C_1 is Motional Capacitance; C_L is the Load Capacitance of the circuit and C_o is the shunt capacitance.

Typical Values

Frequency	Vibration Mode	C_1 (ff)	C_0 (pF)
1.0 to 1.999MHz	Fundamental	5 to 8	3
2.0 to 3.999MHz		6 to 12	
4.0 to 6.4999MHz		8 to 20	5
6.5 to 30.0MHz		16 to 25	6
21.0 to 90.0MHz	3rd Overtone	1.0 to 2.5	
60.0 to 150.0MHz	5th Overtone	<0.70	
85.0 to 210.0MHz	7th Overtone	<0.40	

Fig. 8; Typical Crystal Pullability

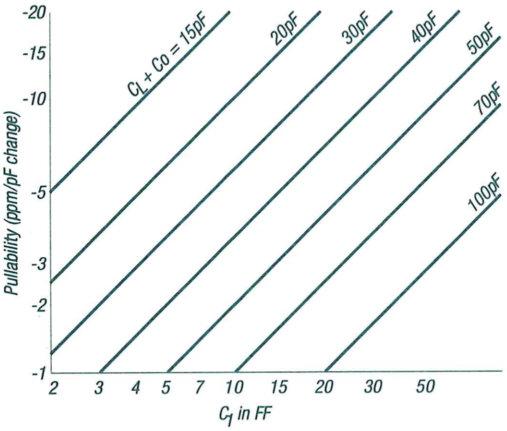


Fig. 5; Parallel/Series HC49 & HC50 @ 30pF max

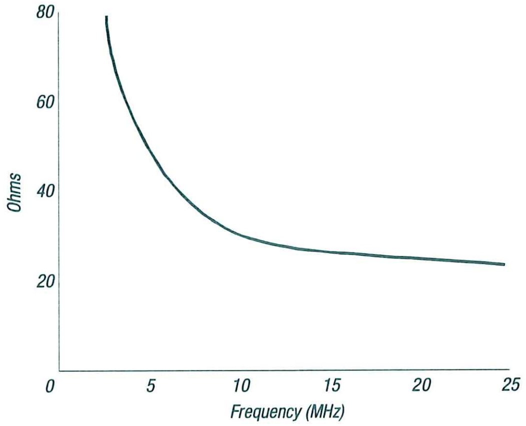


Fig. 6; Parallel/Series HC51 & HC48 @ 30pF max

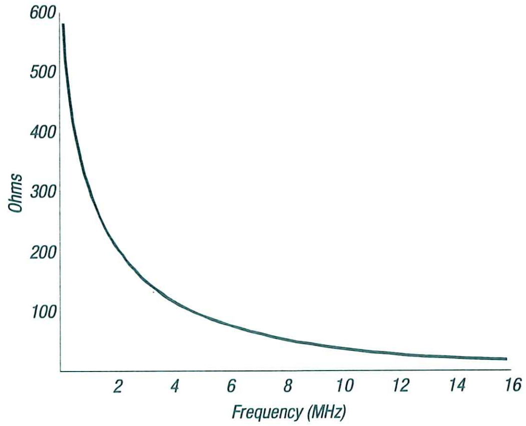
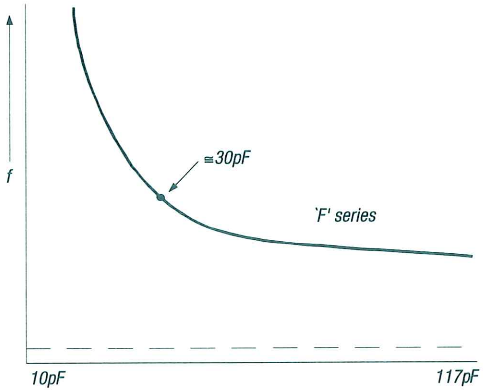


Fig. 7; Frequency/Load Capacitance



BT CUT CRYSTALS

In the frequency range 1 to 200MHz, AT-cut crystals are normally chosen as they represent the best compromise between temperature related frequency stability, frequency accuracy and pulling activity (adjustment of frequency by external capacitance).

However, above approximately 27MHz AT cut crystals are only available operating in an overtone mode. Operation in an overtone mode necessarily restricts the design engineer by requiring circuit designs of greater stability than normal.

There is always a risk if the oscillator design is insufficiently rigorous for the frequency to revert to the fundamental mode of operation when the oscillator has been apparently designed to run in the third overtone mode. Additionally, crystals operated in the overtone mode often exhibit spurious responses within 200kHz of the main response and unless the ratio of the main response to the spurious is of the order of 4:1 the oscillator will run on the spurious response and so give an incorrect frequency.

Fundamental BT Cut Crystals

To overcome the above problems IQD Ltd, has designed a range of BT-cut crystals which operate within the fundamental mode over the frequency range 18 to 46MHz, thereby almost doubling the frequency range over which crystals operating in the fundamental mode are available. These crystals are 1½ times thicker than AT-cut crystals which allows them to be economically produced at higher fundamental frequencies. When introduced into an oscillator circuit, BT-cut crystals will run without any of the problems described above.

Specifications

- Holder style HC49U
- Maximum frequency calibration at 23°C = ±2.5ppm
- Frequency stability –10 to +60°C = ±30ppm

Fig. 10 shows typical frequency variations against temperature.

Overtone BT Cut Crystals

BT-cut crystals are also available operating in overtone modes 3rd, 5th, 7th etc. In each overtone mode they are able to operate at a higher frequency than the equivalent AT-cut would be able to do. This will allow oscillators to be designed having higher frequencies than are normally obtained for any given overtone mode.

Fig. 9; Overtone Response of a Quartz Crystal

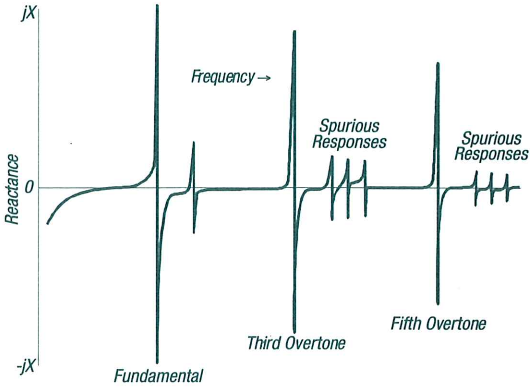
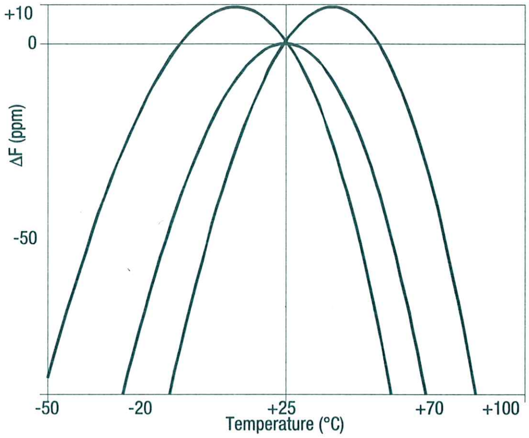


Fig. 10; Typical Frequency vs Temperature Curve



CRYSTAL OSCILLATOR CIRCUITS

In order for a circuit to oscillate there are two main criteria (a) that it has positive feedback and (b) a loop gain greater than 1. With a crystal as a series element in the loop and no other frequency-sensitive elements in the circuit, it will oscillate at the crystal's fundamental series resonant frequency. A quartz crystal always tries to oscillate at its fundamental frequency; therefore to force the crystal to oscillate at an overtone frequency circuit changes must be made.

When the oscillator circuits feedback loop is first closed, sine wave oscillation begins and the amplitude increases until overload occurs. The waveform at overload becomes a clipped sine wave and finally approaches a square wave at heavy overload. Crystal oscillators can usually provide either a square wave or sine wave output. The signal driving the crystal is most often a square wave and the signal out of the crystal is always a sine wave. Either waveform can be used for an output by tapping the appropriate point in the circuit.

Series/parallel Resonance

All crystal oscillators operate at series resonance. What is usually meant by parallel resonance is that the crystal has a high load impedance across its terminals and that the crystal has been adjusted to accept this load. Series resonance physically exists in the crystal, but parallel resonance exists only as a crystal measurement phenomenon.

Below 150kHz

The relatively high equivalent series resistance of crystals in this frequency range demands a high amplifier gain. This can be provided as shown in Fig. 11 by employing two cascaded common emitter bipolar stages. Component values are indicated for frequencies down to 50kHz.

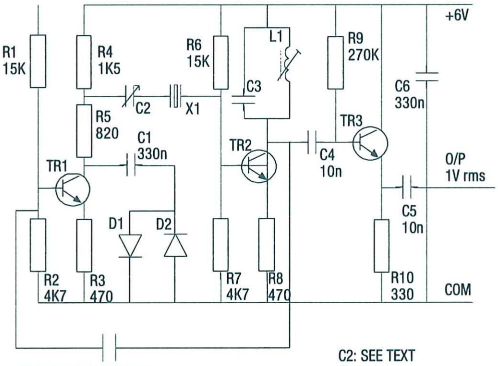
The diodes D1 and D2 in the collector circuit of TR1 limit the crystal drive level to avoid damage and the tuned circuit in the collector of TR2 adds some selectivity. The crystal should be calibrated at parallel resonance with the mid value of the trimmer capacitor C2. With series calibration a 1nF fixed capacitor should be substituted for the trimmer. In the latter case, a limited trimming range can be obtained by adjustment of L1.

150 to 550kHz

DT and CT are the usual cuts for crystals in this frequency range and again, a selective amplifier is preferable in order to suppress unwanted modes - the principal unwanted mode being at about twice the frequency of the wanted one. A suitable circuit is given in Fig. 12.

L1, which must be initially adjusted for oscillation near the crystal frequency with the crystal shorted, may be used as a fine frequency trimmer. Series resonance crystal calibration should be specified but parallel resonant crystals may be used if C1 is replaced by a capacitor whose value is equal to the crystal load capacitance.

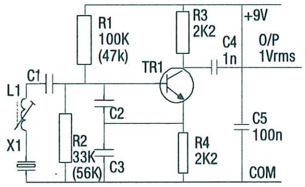
Fig. 11



TRANISTORS: BC 108 type
DIODES: N4148 type
L1: 800-220 microH

C2: SEE TEXT
C3:
50-75kHz: 4.7n
100-150kHz: 2.2n

Fig. 12



TR1: BC 108 type

L1
150-300kHz: 800-2200 microH
300-500kHz: 360-960 microH
C2 & C3
150-300kHz: 1n
300-550kHz: 680p

0.95 to 21MHz

The circuit shown in Fig. 13 is designed for use with high stability AT cut fundamental mode crystals calibrated at parallel resonance. Specify 30pF load capacitance (or 0.95 to 10MHz and 20pF for 10 to 21MHz.

15 to 105MHz

Figs. 14 and 15 give circuits suitable for operation with 15 to 63MHz third and 50 to 105MHz fifth overtone series resonant crystals respectively. When ordering an overtone crystal, reference must be made to its fundamental frequency since it is not an exact sub-multiple of the overtone frequency. Overtone crystals are produced and calibrated specifically for operation at their marked frequencies. With the crystal temporarily shorted, L1 is adjusted for oscillation near the crystal frequency it may then be used as a fine frequency trimmer.

By including a tuned circuit at twice or three times the crystal frequency in the collector TR1 of these circuits, it is possible to extract, from the collector, harmonics of the crystal frequency. Such an approach offers an easy and economical solution to VHF crystal oscillator design.

Above 105MHz

The low reactance of stray circuit capacitances at these high frequencies can make a reliable oscillator design difficult to achieve. To help prevent oscillation not controlled by the crystal, the static capacitance Co of the crystal is often tuned out with a small parallel inductance – L2 in Fig. 16. L1 in the circuit is tuned for maximum output but it can also serve a fine frequency trimmer. Alternatively, the frequency can be trimmed by inserting variable reactance in series with the crystal.

At these frequencies, it may be necessary to obtain correlation of the oscillator frequency with crystal frequency as measured by the crystal manufacturer. If high accuracy is required therefore, it is important to experiment with a sample crystal on which the manufacturer's precise frequency reading is known. Any discrepancy between the crystal and oscillator frequencies can then be remedied by calling for an offset calibration tolerance for further crystal supplies.

Fig. 16

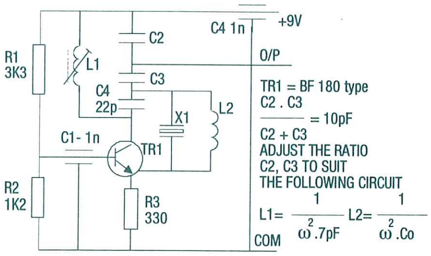
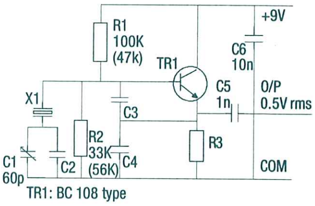
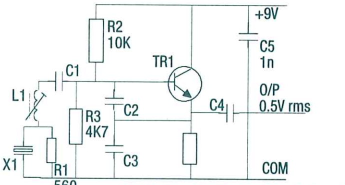


Fig. 13



f(MHz)	R3	C2(pF)	C3(pF)	C4(pF)
0.95-3	3K3	not used	220	220
3-6	3K3	33	150	150
6-10	2K2	33	150	150
10-18	1K2	not used	100	100
18-21	680	not used	68	33

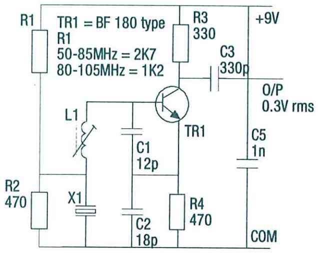
Fig. 14



TR1: BC 108 type

f (MHz)	C1 (pF)	C2 (pF)	C3 (pF)	C4 (pF)
15-20	100	100	68	33
20-26	100	100	68	33
26-48	100	68	47	33
48-63	68	33	15	15

Fig. 15



TTL Clock Oscillators

Many circuits have appeared over the years which use TTL inverters and gates as the active elements. Often, such designs are prone to oscillate at unwanted frequencies or, for a variety of reasons, do not operate properly. Even certain integrated circuits which have been designed specifically for the purpose can be troublesome. As a general rule, extensive testing should be done on these circuits to make certain that the design is not marginal and will not result in belated problems.

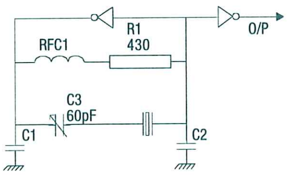
Figs. 18 to 20 illustrate some possible arrangements for use with the 7400, 7402, 7404 etc. Unused inputs of NAND gates should be connected to the positive supply and those of NOR types, to earth. The approximate frequency ranges shown apply only to standard TTL ICs; although with higher value bias resistors in Figs. 18 and 19, the low power families can be used to advantage. In these two circuits, the value of C1 and C2 if found to be necessary, should be determined experimentally. For the frequency range 4 to 14MHz, the circuit of Fig. 20 will give good results.

TTL gate circuits cannot be fully recommended if the highest stability is required. Random phase shift within the IC will cause jitter and the relatively high crystal drive level does not make for good long-term stability.

A conventional discrete component oscillator such as one already described, followed by a buffer amplifier provides a better way of obtaining a stable design. A suitable buffer is shown if Fig. 17 in which the resistor R2 decouples the supply to the oscillator. The insert shows a complementary version of the buffer amplifier which can be used for a faster rise time when feeding capacitive loads.

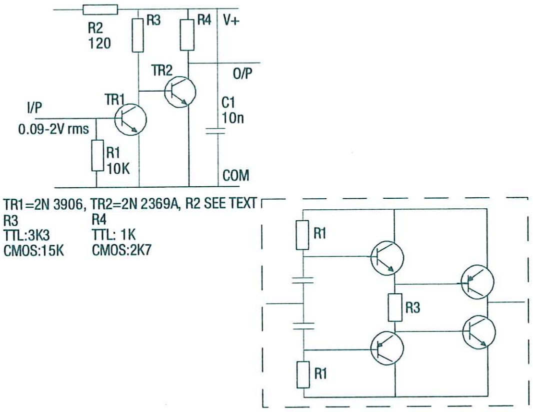
For operation of the circuits of Figs. 12 and 13 from a 5V supply, the values for R1 and R2 shown in brackets should be used; in order to reduce the output to a level suitable for the logic buffer, reduce R3 in Fig. 12 and increase C3 and C4 in Fig. 13. For the latter circuit, crystals calibrated for 30pF load capacitance can now be specified for use up to about 15MHz.

Fig. 20



f1(MHz)	C1 (pF)	C2 (pF)	RFC1 (microH)
4-6	330	220	100
6-9	330	180	68
9-11.5	220	150	39
11.5-14	330	120	22

Fig. 17



TR1=2N 3906, TR2=2N 2369A, R2 SEE TEXT
R3 TTL:3K3 CMOS:15K
R4 TTL: 1K CMOS:2K7

Fig. 18

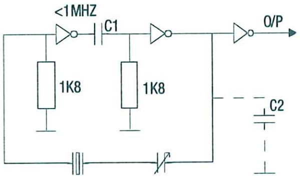
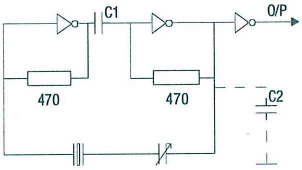


Fig. 19



CMOS Clock Oscillators

Fig. 21 shows the circuit of a typical CMOS inverter oscillator in which the crystal is connected in a pi-network and operates at parallel resonance. Again, only one gate input is connected to the crystal; unused inputs are tied to the appropriate supply rail. Simple formulae for calculating the values of Ca, Cb and R are given which will result in a reliable general purpose design for use up to about 3MHz. However, the actual values used may differ slightly owing to variations in the stray capacitances of individual layouts. The value of R is expressed in terms of the crystal load capacitance CL and its equivalent series resistance at parallel resonance Re. Re in turn is shown in terms of R1, CL and Co; where R1 is the maximum crystal motional resistance and Co, the static capacitance. Values of R1 and Co for a particular crystal type and frequency may be obtained from IQD upon request. If frequency trimming is required, a trimmer capacitor can be fitted in parallel with Cb and the fixed capacitor reduced accordingly.

If connections to the sources of each FET in the inverter are available, the resistor value calculated for R may be inserted at these points, the single series resistor being no longer used. This arrangement, which is illustrated in Fig. 22 gives better stability than the standard configuration due to negative feedback.

For operation above 3MHz, the resistor R is omitted and the crystal connected directly between the inverter input and output. The two pi-network capacitors will now have the same value and their series combination plus inverter capacitances and strays will be equal to CL. Low values of CL, for example 12pF, and/or a high supply voltage may be necessary for reliable operation.

If preferred, a discrete component oscillator together with the logic buffer of Fig. 17 can be used. The power consumption however will be considerably greater than that of a CMOS inverter oscillator.

Frequencies 20 to 200MHz

The schematic of this VHF harmonic oscillator is shown in Figs. 23 & 24. The crystal operates at its harmonic

Fig. 24

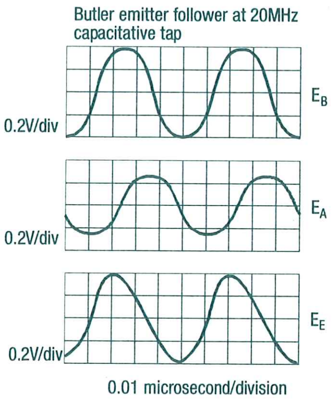


Fig. 21

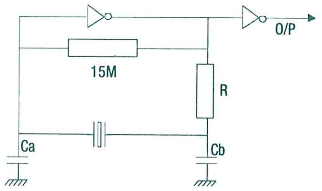
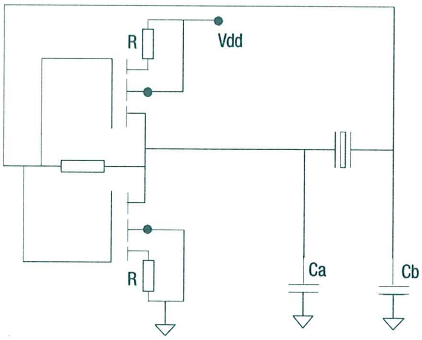
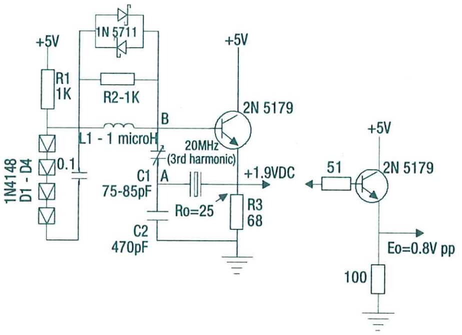


Fig. 22



Ca = 1.1 CL
Cb = 4 CL
$R = -1/(11w^2 CL^2 Re)$
where
Re = Rl (1 + (Co/CL))

Fig. 23



and is tapped into the capacitive side of the LC tank circuit. The circuit has no parasitic effects of any kind.

There are no 2.6V zener diodes available, so four signal diodes are cascaded in series for base biasing. The emitter's output resistance that drives the crystal is 25ohms. The crystal load impedance is mostly capacitive and is one or two times the impedance of C2 (35ohms), depending on the value of C. The crystals internal series resistance Rs is between 30 and 40ohms.

The circuit works very well and the absence of parasitics is a big help. By tuning C, the oscillation frequency can be set either at or slightly above (2ppm) the series resonance.

Figs. 25 & 26 show typical values for 50MHz and 100MHz operation.

Integrated Circuits as Oscillators

A large number of integrated circuits are available for use as an oscillator or include a crystal oscillator. Many existing IC's require only the attachment of an external crystal while some require other components as well. There are three main types of oscillator, the first provides a single bi-polor or field effect transistor to which the external crystal and feedback network can be attached. For this class of circuit the designs shown for transistor oscillators are directly applicable and the frequency stability is generally good.

The second class of circuit, often using MOS technology, provides a gate which can be used as a crystal oscillator. The frequency stability is generally equivalent to that of oscillators using discrete gates of the same type.

The third class of circuit is designed with a multi-stage amplifier on the chip and the external crystal either closes the feedback path from the amplifier output to its input or it serves as a frequency-selective by-pass at some point in the amplifier. Many of these circuits are used as clock drivers for microprocessors, as frequency synthesizers, modems, TV circuits, phase-locked loops and the like. As might be expected, the frequency stability varies greatly with the design and while some are good, others are very poor indeed.

While it is desirable in the design of integrated circuit oscillators to use a set of analytical tools, the detailed equations for oscillation are generally too complex to be useful. Two approaches are presented here based on the terminal parameters of the integrated circuit. In those circuits where the crystal acts as a frequency-selective by-pass in the amplifier which is internally cross-coupled, it may be convenient to think of the circuit as a negative-resistive element in series with an inductance and a series compensating capacitor C in series with the crystal. For on-frequency operation with a series resonant crystal, C should be resonant with Lo at the nominal frequency of the crystal. The resistance Rn is a negative value and must be larger in magnitude than the equivalent resistance of the crystal for oscillation to take place.

It is possible to determine the magnitude of Rn in several ways. Perhaps the most obvious is to place a crystal

Fig. 25

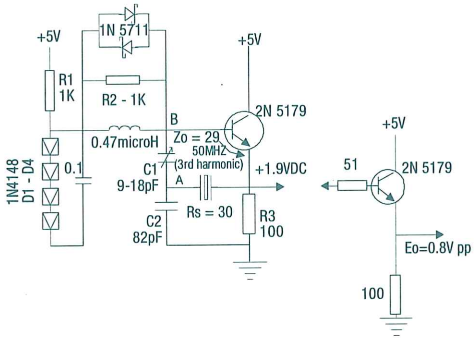
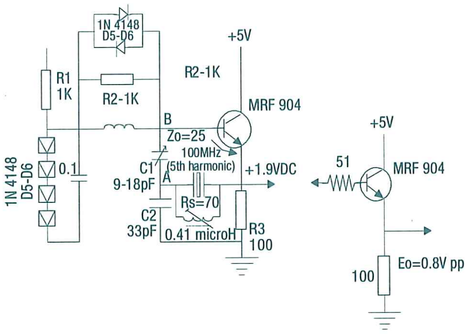


Fig. 26



between the appropriate terminals of the IC and add series resistance until oscillation will no longer occur. The magnitude of the negative resistance is then given by the sum of the crystal resistance and the additional series resistance. The magnitude of the oscillator inductance can be found by noting the difference between the frequency of oscillation and the series resonant frequency of the crystal (without C or the series resistance) and calculating.

$$L_O = \frac{1}{(2\pi_{fs})^2\left(\frac{C^{\,1}}{2\Delta f/f} - C_O\right)}$$

It can also be found experimentally by selecting C to obtain the series resonant frequency of the crystal. Then:

$$L_O = \frac{1}{(2\pi_{fs})^2 C}$$

Since the equivalent inductance will in general vary as a function of frequency it should be computed near the nominal frequency of the crystal used.

It is desirable to minimise the equivalent inductance of an oscillator for several reasons. First the equivalent inductance of an oscillator will change with temperature and supply voltage, causing the oscillator frequency to drift. Secondly, it may result in free-running oscillations through Co of the crystal.

The equivalent inductance is a result of phase shift in the amplifier and can be minimised in the design by using as few stages as possible and by increasing bandwidth of the amplifier. The negative resistance will of course be a function of the gain of the amplifier and the impedance level where the crystal is placed.

Test data on several IC's of the cross-coupled type shows a wide variation in the equivalent inductance, from approximately 1- 2μH to greater than 250μH over the frequency range from 1 to 20MHz. Therefore, while some IC's operate with the crystal near series resonance, others operate as much as 1% low in frequency.

Frequencies 1 to 20MHz

The schematic of this series resonant oscillator at 1MHz and the circuit waveforms in Fig. 27. This circuit has outstanding performance and works very nicely off a 5V supply. Waveforms at the crystal are very good. The frequency changes very little when power supply voltage or temperature are changed. The low ECL drive voltage keeps crystal dissipation low and the low ECL drive resistance R_L, which gives very good frequency stability. The ECL receiver format is well adapted to high frequency oscillator circuits. At high frequencies crystals are low impedance devices and ECL circuits can drive low impedance loads down to 50r easily. Input resistances of ECL circuits are high and they are also linear over the ECL voltage range. As shown in Fig. 28 the crystals square wave drive waveform at Pin 3 has a definite slope during transition between binary states, indicating the ECL unit is operating as a linear amplifier during the transition interval.

Fig. 27

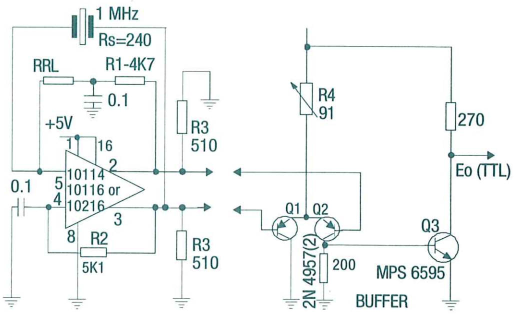


Fig. 28

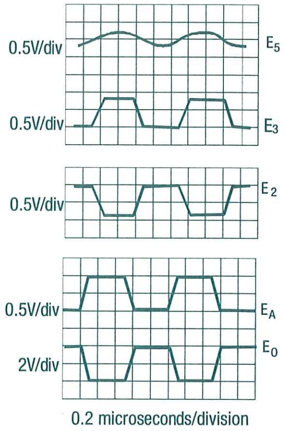


Fig. 29 shows the circuit at 20MHz. The crystals internal series resistance R_S is 7r; the crystals load resistance R_L is 10r. At 20MHz the ECL receiver has to be able to drive a 17r load (R_S+R_L=12r), a very low value. The receivers output resistance is controlled by the ECL emitters output current, which is in turn controlled by the emitters pulldown resistor R_3. R_3=510r works well at 1MHz but has to be decreased to 100r at 20MHz to get the ECL output resistance down low enough to provide a reasonable drive waveform to the crystal.

There are three ECL receivers in one DIP. One of the two unused ones could be used as a no-cost buffer between the oscillator and the two transistor buffer, but the circuit will oscillate spuriously when the crystal is removed. Because of this the ECL receiver should not be used as a buffer.

Frequencies up to 500kHz (CMOS)

Each inverter in Fig. 32 has negative feedback round it to ensure that it is biased in the middle of its linear region, so that oscillation will always start when power is applied. The feedback resistor round the first inverter is divided into two series resistors and the centre point is bypassed to ground. R_L is used as the crystals load resistor and is set equal to or somewhat less than the crystals internal series resistance R_S. Figs. 30 & 31 shows good waveform at the crystal. The spikes on the crystal sine wave output appear to be due to sharp edges of the crystals square wave drive feeding through on the crystals shunt terminal capacitance CO.

The overall performance of this oscillator is average with on/off times of 2.45/2.55µsecs. This is due to its frequency sensitivity to power supply voltage changes being higher than it should be. This high sensitivity to power supply voltage changes seems to be characteristic of most CMOS IC's.

Fig. 32

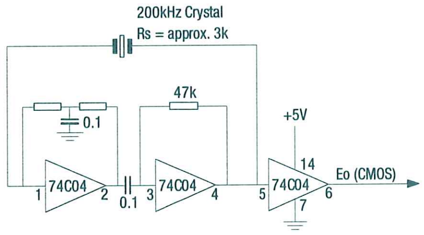


Fig. 29

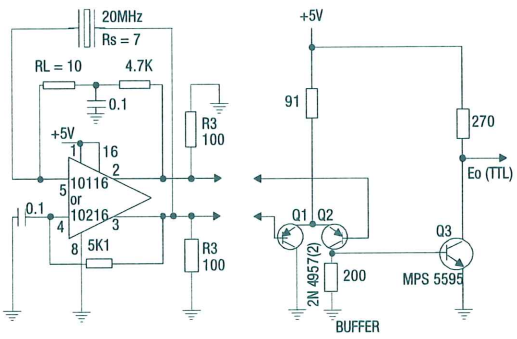


Fig. 30

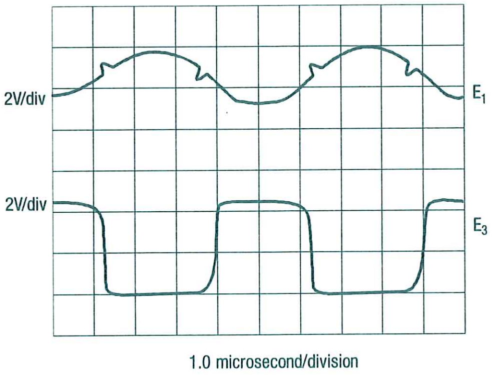
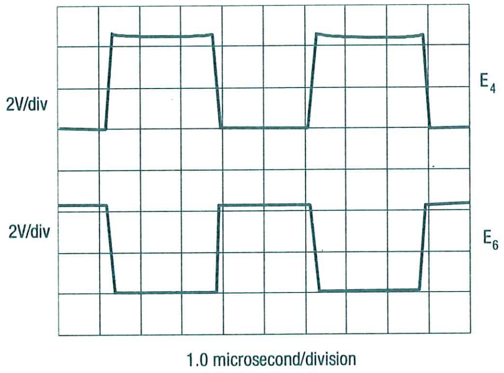


Fig. 31



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IQD CREDIT APPLICATION FORM

Company Details

Full trading name(s) ....

Trading address ....

....

Tel no.: .... Fax no.: ....

Company registration no. .... Annual sales £....................................

EC VAT Number (where applicable) ....

Your bankers name ....

Address ....

....

Monthly credit requirement £..

Person responsible for payment of account on time ....

References

Name, address & telephone no. of two principal suppliers

1) ....

....

Approximate value of annual purchases from this supplier ....

2) ....

....

Approximate value of annual purchases from this supplier ....

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"Acceptance of an order is subject to availability of manufacturing materials; we reserve the right to revise prices due to fluctuations in international exchange rates. Ownership of the goods the subject of an order shall not pass to the purchaser until actual payment is received. No contract for supply of made-to-order items can be cancelled once manufacture has started. Payment terms are strictly 30 days from end of month of invoice for approved credit accounts. If any invoice remains unpaid beyond the agreed terms all other unpaid invoices will immediately become due and full payemnt will become due for any oustanding orders for made-to-order items. Interest will be charged at 2% per month compound on overdue invoices. Only English law will apply."

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We hereby request you to open a credit account.

Directors declaration:

"I being an authorised officer of this business, do agree to abide by IQD's standard terms of business and that payment of all accounts will be received by you (our supplier) within your stated credit terms. I appreciate that adherence to this obligation is the essence of the contract between us."

Signed .... Date ....

Name (please print) ....

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Business Activity ....

.... No. of Employees ....

Business reply service
Licence no: BS 4995

2

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CREWKERNE
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TA18 7BR

Business reply service
Licence no: BS 4995

2

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Business reply service
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CERAMIC RRESONATORS
QUARTZ CRYSTALS
OVEN CRYSTALS
CLOCK OSCILLATORS
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TCXOs
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SM CERAMIC RESONATORS
SM QUARTZ CRYSTALS
SM CLOCK OSCILLATORS
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IQD Limited, Crewkerne, Somerset TA18 7AR, England
Tel: Sales +44 460 74433 Admin: +44 460 77155 Fax: +44 460 72578

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